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ABSTRACT

The workshop on the popularization of science was the first of what the organizing institutions hoped would be a series of workshops on this important theme. It was held to complement the efforts of various institutions and organizations in the whole area of technological acculturation so that the benefits of science may be understood by and passed on to the general public. The 50 participants drawn from Gambia, Sierra Leone, Ghana, Nigeria, Uganda, Kenya, Tanzania, Zambia, Malawi, Lesotho, Botswana, Swaziland, Zimbabwe, Mauritius, Malta and Cyprus spent most of the time at discussions and practical sessions. In particular the practical sessions focussed on scientific writing and talking, appearing before radio and TV, and appearing for press conferences. A number of recommendations were made at the discussion sessions which it is hoped would lead to effective regional and Commonwealth cooperation as well as national programs in science popularization. The following papers are included: (1) "Keynote Address" (D. A. Bekoe); (2) "The Role and Training of the Science Communicator" (E. Apea and M. N. G. A. Khan); (3) "Mechanisms for Popularization of Science" (Andrew Salisbury); (4) "Popularization of Science through the Media" (Jerusha Castley); and (5) "Science Writing" (Abdallah Ngovovo). A summary of the country reports, summaries recommendations are provided. The workshop opening remarks, the opening speech, closing remarks, the workshop program, and a directory of participants are appended. (KR)

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Popularization of Science

REPORT OF A COMMONWEALTH REGIONAL WORKSHOP
15-19 APRIL 1985, LUSAKA, ZAMBIA

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POPULARIZATION OF SCIENCE

REPORT OF A COMMONWEALTH REGIONAL WORKSHOP

LUSAKA, ZAMBIA

15 - 19 APRIL 1985

Commonwealth Science Council
and
Education Programme
of
Human Resources Development Group
Commonwealth Secretariat
Marlborough House
Pall Mall, London SW1Y 5HX

DECEMBER 1985

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PREFACE

The workshop on Popularization of Science was organised jointly by the Commonwealth Science Council and the Education Programme of the Human Resource Development Group of the Commonwealth Secretariat. It was largely funded by the Commonwealth Fund for Technical Co-operation and hosted by the Zambia National Council for Scientific Research.

This was the first of what the organising institutions hope would be a series of workshops on this important theme. It was held to complement the efforts of various institutions and organisations in the whole area of technological acculturation so that the benefits of science may be understood by and passed on to the general public.

The workshop was held at the Zambia Institute of Mass Communication in Lusaka from 15 to 20 April 1985. It was formally opened by the Honourable M. Sianga, Minister of State for Higher Education. Dr. S. M. Silangwa, Secretary-General of the Zambia National Council for Scientific Research was the chairman.

The 50 participants drawn from the Gambia, Sierra Leone, Ghana, Nigeria, Uganda, Kenya, Tanzania, Zambia, Malawi, Lesotho, Botswana, Swaziland, Zimbabwe, Mauritius, Malta and Cyprus spent most of the time at discussions and practical sessions. In particular the practical sessions focussed on scientific writing and talking, appearing before radio and TV, and appearing for press conferences. A number of recommendations were made at the discussion sessions which it is hoped would lead to effective regional and Commonwealth Co-operation as well as national programmes in science popularization.

The Commonwealth Secretariat and the Commonwealth Science Council wish to acknowledge their deep gratitude to Unesco for funding assistance and for allowing the Director of its Africa regional office, Dr. D. A. Bekoe to be the workshop's Keynote Speaker, the IDRC (International Development Research Centre) for providing resource persons and to the Zambia National Council for Scientific Research for the excellent hosting facilities and hospitality provided. Special thanks are due to the Chairman, Dr. S. M. Silangwa, the Keynote Speaker, Dr. D. A. Bekoe and the resource persons, Dr. A. Salisbury, Ms. J. Castley, Ms. Fibi Munene and Mr. A. Ngororo.

CHAPTER 1: KEYNOTE ADDRESS

Dr. D. A. Bekoe, Director, UNESCO Regional Office
for Science and Technology for Africa

I would like to begin by thanking the organisers of this workshop for inviting me to give the keynote address. This is an occasion which provides me with the opportunity to outline to you some of the work which UNESCO has been doing in the field of popularization of science and to express a few thoughts of my own which I trust will help the workshop in its deliberations.

Any workshop or seminar on the popularization of science must address itself seriously to some or all of the following aspects: why, what, to whom, by whom, how - and finally the constraints and problems. Before I go into the details of each of these aspects, I would like to stress the importance of the popularization of science world-wide and in particular in the less developed countries. When we come to examine the means by which popularization is carried out, it will be obvious that this has been a pre-occupation in many parts of the world over a long period. There are good reasons for this and although the relative importance of each reason may vary from region to region and from country to country, all of them apply nevertheless.

As far as Africa is concerned, one of the early systematic attempts at the intergovernmental level to draw attention to the subject was on the occasion of the Conference of Ministers of African Member States Responsible for the Application of Science and Technology to Development (CASTAFRICA), organised at Dakar, Senegal on 21-30 January 1974 by Unesco with the co-operation of the Economic Commission for Africa (ECA) and the Organisation of African Unity (OAU). At that Conference one of the barriers to scientific and technological progress was identified as a lack of basic scientific education among the population at large. It was therefore resolved that in order "to create a public awareness of the importance of science and technology in socio-economic development", Unesco should "continue to provide the necessary support for the promotion of the public understanding of science and technology in Africa" and that "African countries which have not done so take concrete steps to implement the recommendations of the first African Regional Seminar on the Promotion of Public Understanding of Science and Technology which was held in Lusaka, in 1971, under Unesco's auspices".

There have been many other conferences at which the subject of popularization has been discussed and recommendations for action made. And there have been meetings at the intergovernmental as well as non-governmental levels. At a Regional Symposium on the Utilisation of Science and Technology for Development in Africa held at Addis Ababa in 1970, one of the resolutions was to promote the understanding of the role of science and technology among the African peoples. It was this resolution and a previous Unesco General Conference resolution which led to the 1971 Lusaka meeting. Unesco's involvement seems to have experienced a rather long interruption until 1983 when "The Second African Seminar on the Promotion of Public Understanding of Science and Technology and Regional Plan for Scientific and Technological Exchanges in African Countries" was held in Nairobi, Kenya. Most probably the idea was taken up in April 1984 at a meeting held again in Nairobi on the

theme "Communication of Technological Skills to Rural Areas" followed in June 1984 by another meeting on the broader subject in Lome, Togo.

The initiative taken by the Commonwealth Secretariat in organising this meeting cannot be an isolated one. I am sure a similar series of meetings can be traced over the years to demonstrate the Secretariat's sustained interest in the subject.

Let us now turn to the basic issues I raised at the outset. First of all, why? I have already referred to the basis of the CASTAFRICA resolution on this subject, i.e. that popularization of science is necessary in order to reduce the barriers to scientific and technological progress. But from a more fundamental point of view, science is a part of the culture of any modern civilisation. It is therefore necessary that every member of society be given an insight into science: the scientific method and the search for knowledge and solutions to human problems; some recent trends and advances in science and technology. Such insight provides the basis for simple judgements about topical scientific issues: nuclear war and how this is different from non-nuclear war; genetic experimentation and the improvement of crops and new methods of drug manufacture or treatment of disease; the fight against desertification etc. As the then Minister for Education of Zambia stated during his opening address to the 1971 Lusaka Seminar "It is possible to exist with little or no knowledge of science, but it is almost impossible today to lead a full, satisfactory life with little or no knowledge of science". After pointing out the importance of training a work force of competent scientists and technicians as quickly as possible to seek solutions to our many problems, he went on: "Experts cannot bring about change in a vacuum. They need the co-operation of an informed public, they need a community which can adapt itself to the changing values and challenges of life". In these days when we constantly refer to the "democratisation of decision-making", most if not all of us must have enough background to appreciate the issues at stake in any important decisions before and after they have been made. And many decisions at the personal, community, governmental or international level these days involve science and its applications. We also need to increase interest in the young in order to attract a reasonable proportion of them into careers in science and technology. For all of us, young or old, a knowledge of science stimulates innovation in finding solutions to our many everyday problems. Finally, it is important for each of us to have an idea of what science can do and, of equal importance, what it can **not do.**

I should mention at this point that popularization of the history of science will provide the perspective and inspiration which many of our governments and young citizens need to make great efforts towards higher levels of achievement in science. The spectacular growth of modern science in the industrialised countries has taken place over a relatively short period in the recent past, not more than about fifty years. Yet centuries before the great Galileo, there were many great scientists - mathematicians, men of medicine, physicists, etc. - who lived and worked on the continents of Africa and Asia and contributed so much to the birth of modern science in Europe. By some accident of history, the contributions of Africa and Asia to modern science

and technology has been relatively little. The knowledge that we had been in the forefront many centuries ago should give us the confidence to make greater efforts today.

What do we disseminate or popularize? When we talk about popularization of science and technology, we seldom state clearly what we want to popularize. We often get carried away by the conviction that popularization in itself is something good. However, a lot more can be achieved if we try to examine closely what exactly has to be popularized. I am of the opinion that there is no explicit, comprehensive, and universal answer to this question. It is useful to approach the answer through a series of questions or a set of criteria. What are the immediate and long-term needs of the community or country or region we wish to address? In particular, are there any subjects of topical interest for which some scientific background would be useful? The long-term needs may include the production of relevant scientific and technological manpower and the inculcation of the scientific attitude. For any particular means, who are the people to be addressed, what are their backgrounds and interests? What are the interests of the communicator? What kind of reaction or effect do we want to produce? How much factual knowledge do we want to communicate to produce this effect? How quickly?

A study carried out in the United States in 1980 is of particular relevance. In this study, the public was divided into "attentives" and "non-attentives". Members of the former group, estimated at about 18 per cent of the general public, were identified as having greater interest and knowledge with regard to science than the public at large. According to this survey, the distinguishing characteristics of the attentives was education: 55 per cent of those in the sample with graduate degrees were in the attentive group, compared with only 12 per cent of those who had finished their education with secondary school.

Although the results of the survey are more related to industrialised rather than to the less developed countries, some conclusions are interesting in the African context as well. The study suggests that the "attentives" and "non-attentives" have very different information needs and it seems that the media are responding inadequately to those different needs. The attentive public is already interested in organised science, has a certain level of information, and makes efforts to acquire additional information. In contrast, the non-attentive group lacks interest in science and would be highly unlikely to consume more sophisticated information even if it were available. Therefore, the message targeted to the non-attentive public should be persuasive in nature and seek first to stimulate interest in science. Reaching the non-attentive group is therefore our major problem in popularization of science and technology. The results of this study deal in an implicit way with the "what" and "to whom".

Depending on the target group, we have to consider what we communicate by way of general contribution to culture: the scientific method and attitude; careful observation, deduction, questions or implications, experimentation, further observation, theories and hypotheses, and the part played by intuition. What do we communicate in the realm of information on matters of interest in the immediate environment, such as food production, use of solar energy, health, disease, manufacture of consumable

products, preservation of the environment, electricity, radio, television, satellites? In some cases, it is necessary to provide simple but in-depth information on the frontiers of science, such as the problem of cancer and its treatment, immunisation, exploration of outer space. On many occasions, we have to decide what background information is required for understanding some key issues at the highest level of decision-making, such as what aspects of technology should be given the highest priority in a given country or group of countries, given their resources and aspirations. What meaningful questions should an individual entrepreneur ask in order to arrive at the best use of his resources? Finally, within the categories of attentives and non-attentives, what do we provide for the in-school population?

The next issue is how. This, I believe, is the immediate task before this workshop for the five days that you will be spending in Lusaka. As the notice for the meeting points out, the objectives of the workshop are two-fold: first, to develop better awareness of the various mechanisms involved in the populatization of science and secondly, to promote training at in-country and regional levels to facilitate popularization as well as increase public understanding of science. The range of backgrounds and professions represented here is such that you will have to consider the whole array of mechanisms, if each of you is to obtain a better appreciation of his own working tools as well as a reasonable working knowledge of the others. I am informed that we have science teacher educators, ministry of education officials concerned with children in first cycle institutions and others science readers, etc. In practical terms, the workshop aims at elaborating the mechanisms for the popularising of science and expects to train or orient participants through practical exercises and case studies. There are mechanisms designed for children of different age groups in school as well as out of school; others are specially meant for adults: non-scientists and scientists. Scientists are generally included in the class of attentives; their special needs usually include information in simple scientific language about what is going on in fields of science other than their own. Non-scientists may be attentive or non-attentive and must be treated accordingly. Briefly, one may list the major mechanisms as children's science books and cartoons; formal school classes; school science fairs and exhibitions; science museums; radio and television; films; public lectures; newspapers and popular magazines; agricultural shows; industrial and other exhibitions; extension pamphlets; science journals for the general reader; and press conferences. What circumstances dictate which mechanisms? Each of these different means of communicating science and promoting its understanding involves a lot of effort and hard work; in fact, quite often, the simpler the mechanism may appear, the greater the amount of thinking, design work and innovation required. As you will be considering many of these in greater detail, I shall not elaborate on the "how" any further.

What are the problems, constraints, and pitfalls that a science communicator faces, even after he has acquired a reasonable mastery of his tools. There is a great temptation to adopt the attitude that because we know what we want to communicate, we can easily put it across. In this respect, I wonder how many of us have not often seen badly-written science books and articles, badly-produced radio and television science programmes and badly-assembled exhibitions? There is more than knowledge of the "what"

required. For success, it is necessary to know about the art and science of presentation. Too often, we try to communicate too much information, or present the right amount in a way that cannot be easily registered, understood and appreciated, or we fail to elicit a response or generate feedback and stimulate follow-up. Here again, I expect that in the more specialised presentations to be made to you during the week, some of these problems and obstacles to successful communication will be raised in more specific contexts.

The first pre-requisite in any personal or group undertaking is that you have the interest and enthusiasm to see it through. I believe we have all demonstrated that by our presence here at this workshop. But these alone are not enough. I hope that by the end of the week we will all have strengthened our capabilities and acquired new tools and expertise in the art and science of the successful and effective popularization of science. Above all, we must be aware of the need to evaluate our efforts and how to do so.

And now, I would like to end on the note of co-operation. Unesco stands for co-operation - among nations and among institutions. I expect that when you return to your institutions, you will remember to share what you have gained with other institutions and individuals in your own and other countries. The Regional Office for Science and Technology for Africa has had a fair amount of co-operation with the Commonwealth Science Council of the Commonwealth Secretariat. We have worked together in the organisation of training courses, workshops and seminars in the earth sciences. We have also had co-operation in engineering education. I am sure there have been other joint activities with Unesco generally. The Regional Office welcomes and appreciates very much this opportunity to extend our co-operation to yet another field. On behalf of the Regional Office and of Unesco, I thank the organisers of the workshop i.e. the Commonwealth Science Council and the Education Programme of Human Resource Development Group, both of the Commonwealth Secretariat, London, for their invitation. I wish all of us a fruitful, pleasant and interesting workshop.

CHAPTER 2: THE ROLE AND TRAINING OF THE SCIENCE COMMUNICATOR

Mr. E. Apea and Dr. M.N.G.A. Khan,
Commonwealth Secretariat

Introduction

> "Science which was formerly only one factor in national policy has now become one of its aims".[1]

It is easy to see why science has gained such prominence in the affairs of nations. Many of the basic amenities of present day life have come about as a result of scientific discoveries. Our already complex society is becoming increasingly dependent on science. As Ingle and Jennings put it, "the future material well-being of mankind will depend on the solution of ecological, energy and resource problems brought about by scientific and technological advances." But, perhaps most important of all, the preservation of democracy will depend on the existence of a scientifically literate community with the ability to contribute in an informed way to decision-making on financing scientific research, determining the scale of national health programmes, the management of natural resources, and the utilisation of the environment.

Unfortunately, as things are at present, knowledge of science is not sufficiently widespread. Instead, society is stratified into two cultures. One group understands the effects of science on human life and thought, the other does not. And it has to be said that those belonging to the latter group are not in a position to participate fully in life! Often they are bound by fear, sometimes fear of science and its links with war; sometimes merely fear of the unknown. How can this fear be removed so as to ensure that each individual has the opportunity to participate fully in, and enjoy living in a scientifically based modern society?

Scientific Literacy

In an attempt to answer that question the concept of scientific literacy has been advocated. As to its form and depth, Morris Shamos of New York University in 1965 wrote:[3]

> "What do we mean when we speak of scientific literacy for every man? Obviously we do not mean competence to the extent of engaging in it professionally. Nor do we mean an encyclopaedic knowledge of scientific facts. We mean, as Wilbur Schramm put it, 'that an educated man should know science in a humanistic way'. He should know it for his general good and because it is part of his culture, just as he is expected to know something of the humanities and social science. He should feel comfortable when reading or talking with others about science. Hopefully he should be able to distinguish between scientific argument and dialect or between science and pseudo-science... He should appreciate the universality of science, that the laws of nature we seek to uncover must apply equally well to civilization on a remote planet in another solar system as to our own, and that

> this universal character of science is one of the three main features (the others are its cumulative nature and its method of testing for the correctness of its statements) that distinguish it from other forms of human knowledge. He should realize that science is the product of man, not of nature, that the so-called 'laws of nature' are man-made laws and that they represent one of man's major intellectual accomplishments. In short, he should have some feeling for the nature of the whole scientific enterprise, for its strengths and limitations, and for its influence on man's intellectual and cultural development."

Some ten years later, Lord Bullock, addressing the U.K. Association for Science Education in 1976, expressed similar ideals when he used these words:[4]

> So much time is spent on the utilisation value of science and what applied science contributes to our practical human needs of food, shelter, health, communications,... that the other aspects of science as the greatest intellectual and cultural achievement of modern man is too often neglected. If this is a true assessment (and I find it hard to think of any of the arts or the other branches of knowledge which could rival it in the past 100 or even 300 years), then surely it ought to occupy a corresponding place in the education of every young person as one of the most important ways in which man learns about himself, and the principal means by which he learns about the physical world in which he lives, about other forms of animate matter and about the framework of space, time and the universe in which all life is contained.

It is clear that both these writers share the view that scientific literacy is not merely the acquisition of basic scientific knowledge, but encompasses also a vision of scientific culture. This belief is shared by Jennifer Frost who, as a result, formulated what she considered to be an irreducible minimum of scientific knowledge and skills for the school leavers of the 1980s. Broadly, her proposals are:[5]

1. Children should be prepared for situations they are likely to meet in adult life in which considerations of science will arise.

   a) They will choose and buy such technical devices as washing machines and music centres. They should therefore be able to understand basic technical information e.g. power consumption: is 1 kW more or less than 100 watts? They should also be able to read and understand instructional manuals accompanying purchases.

   b) Pupils should be able to assess commercial persuasiveness underlying such statements as 'Scientists tell us that...' or 'Contains added oxygen dihydride' and be able to distinguish persuasive from factual language.

c) Pupils should be able to read various meters and scales - gas meters, thermometers etc. Since there are no standard patterns, pupils should be introduced to a range of devices at school.

d) Pupils should gain awareness of potential hazards to safety and health in the home (e.g. electrical hazards). Elementary knowledge of first aid is necessary.

e) As adults they should know how to keep themselves and their families healthy and be able to comprehend and discuss any medical treatment that may be prescribed.

f) Pupils should leave school knowing that such highly technical medical devices as X-rays, isotopes and ultra-sonic scans - and such simple things like eye testing, the measurement of blood pressure - are not magical: hence they should be able to ask intelligent questions about them and interpret the answers.

g) As parents they should be able to answer or at least entertain scientific questions from their children.

2. Children should grow up remaining curious about their environment. As a general social need, children should

a) have some understanding of the natural environment, and of such physical phenomena as flowing water, surface tension, heat transfer, clouds and lightning;

b) have some understanding of man-made environment ever-present in urban life - bridges, embankments, roads and building structures; also of the supposedly natural environment - farming patterns, rivers, the sea shore, parks and gardens. These artefacts can be appreciated only through trying to understand the problems they are intended to solve, and the constraints at work: flood management, water supply, strength of building materials, and so on;

c) be provided with wide experience of making simple gadgets and working models in order to appreciate artefacts in (b) above;

d) develop the necessary skills to take up hobbies with some technical content: gardening, photography etc.

3. General appreciation of science. Children should be able to:

a) take an intelligent interest in references to scientific things in the mass-media - topical subjects such as 'the energy problem', and subjects that trigger the imagination such as cosmology;

b) appreciate that at least some aspects of the world are susceptible of orderly description and prediction.

Jennifer Frost's proposals, as broadly described above, are paralleled by other attempts to teach scientific literacy in school. Of significance at the Commonwealth level were the two interrelated meetings of expects in science and mathematics, and in technical and vocational education, which took place in Cyprus in 1982. Their task was to identify issues in preparation for a proposed Commonwealth Specialist Conference intended to "review the experience of member countries in devising curricula that draw upon the subject matter of science, mathematics and technical and vocational subjects with a view to enabling the generality of boys and girls to profit from the study of these subjects for their personal development and as a preparation for the world of work."[5] Although the conference itself was cancelled, working papers prepared for it, mostly by those who met in Cyprus have been edited and have been distributed to Commonwealth countries.[6]

Communicating Science to Special Groups

Outside the school system information has to be communicated to the general public including scientists and other special groups with specific needs for scientific information.

When scientists are seeking information within their strict research interest, they expect it to be presented in a form that will allow them to judge its validity and significance. Those who seek information outside their specialized areas of research tend to listen to or read reviews, at least in the first place before searching the research literature.

Applied scientists and technologists tend to read a greater range of literature and go to many types of conferences and meetings in order to glean information of relevance to the problems they themselves are trying to resolve. They talk to people across the range, to research scientists on the one hand, and to practitioners and operators on the other, because the latter form an essential link - the innovative link - between research and practice.

The non-scientist at managerial level, the technical administrator, and the political leader, all require information of different types. Not only do they need to know broad outcomes rather than specific details of research findings, they also need to know for what purposes the investigations were undertaken and whether or not the objectives were reached, what resources (both of manpower and equipment) were used, whether the results are of practical significance, and what further work and resources are required before the findings can be used in an applied situation. They cannot judge the value of research without being supplied with information in a form that supplies answers to these questions.

The information needs of operators, e.g. farmer, factory manager, are akin to those of a technologist, but are of a more practical nature. They are more concerned with the application of research findings to existing or potential processes. The research findings must be interpreted for them.

Communicating Science to the General Public

How then can science be communicated to the society as a whole in such a way as to capture interest and maximise its appeal? Providing science can be understood, its appeal is universal.

For many communities, the popularization of science involves informing the public of what science is all about, what its underlying concepts are and how ordinary men and women can develop a world view in terms of attitudes towards scientific matters. But throughout the developing world, many hurdles stand in the path of scientific communication. First, the percentage of literacy in most developing countries is so low that were it to be possible to distribute scientific journals and magazines, not many people will be able to read even the simplest of them. Secondly, not everything happening in science is of equal interest to the general public. Thirdly, some processes in science are so complex and sophisticated that they cannot be translated easily into layman's language. This is especially true of the natural sciences such as mathematics or physics which tend to be above the level of public comprehension.

Oral and visual communication appear to be a more effective way of reaching the layman. In Africa, radio and drama are both popular in communicating with the general public and it is regrettable that these media are not being utilised as much as they might be in popularising science. In India, the theatre group, Jagran[7], is popularising science in ways that could be replicated to advantage in Africa. Jagran are not trying to solve any one particular problem. Through their mime they seek to encourage villagers and slum dwellers to see the causes of their problems and to show that action can be taken to resolve them. They do this by getting people to question their own situations, to understand issues, and, by looking differently at their lives to change and improve them. Jagran have, for instance, depicted disease as a monster which comes each time a child and his father drink dirty water. But when they drink clean tap water they can fight against the monster. Other plays performed by Jagran include 'Monster of Malnutrition' in which a monster represents malnutrition. A little boy is able to kill it once he has started to eat healthy food. Radio, television and film can inform the general public in interesting ways and convey scientific information and advice to special groups e.g. farmers' groups, students. Unfortunately, too much emphasis is often placed on presenting an exhaustive discourse on a subject instead of using these media to convey ideas and concepts which lie within the understanding of the audience. But to be able to do this, an awareness of the kind of information required by the public, and an ability to provide it effectively, are as important as a thorough knowledge of the subject. In this context, the scientist as communicator is only one of a team of specialists, each contributing equally to the task in hand.

More formal symposia, such as conferences and congresses, are valuable for the closely-knit group of people attending them. They provide a venue for the rapid dissemination of new information which can be submitted to immediate, informed criticism. They do not however provide a perfect system, and the success of a conference depends largely on its organisation and the performance of the participants, chairmen, and discussion leaders. Scientists often assume that they have a natural ability to communicate orally. This assumption is often incorrect. In a different category are those conferences convened to bring together scientists and others - economists, government administrators, industrialists, medical practitioners etc. These may fail because of insufficient planning to ensure effective contact. Communicators either supply incorrect or inappropriate information or present it in such general terms that others are unable to relate it to their own situations. Unless there is a careful selection and briefing of speakers, and unless discussions are competently led, such conferences fail to achieve their purpose.

Another form of oral and visual communication is the exhibition and display. As with other kinds of communication methods, the actual form of the exhibit will be governed by the purpose and audience to which the information is directed.

The general public, to which all the above belong when outside their own business or speciality, as well as all others, is society at large. The scientist must report to a public who will judge both whether scientific pursuit is worth the money expended on it and the extent to which the quality of life will be improved by activities and innovations arising from such research.

While oral communication is an effective means of reaching the community, results of a few surveys that have been made in different countries of the source of scientific information by scientists, technologists and operators show that the more specialised the user, the more dependent he is on the written word.[8]

One of the main faults of the scientific publication is its style: its circumlocution, its ambiguity and its clumsiness. It is often hard to read, not always because of its profundity. At first sight, this form of reporting gives the impression of imparting modest and disinterested tone to the writing in order to emphasise the objectivity of the utterances. However, Maddox, the former editor of 'Nature', considers that the characteristics of scientific prose are in reality a symptom of an underlying failure of the author to engage himself fully in the task of communication as much as possible to as many as possible.[9]

A more charitable view, and probably nearer the truth, is that the reporting of research results has been divorced from the research itself, instead of being regarded as an integral part of it. A conscious effort on the part of authors would achieve much. An even more effective means of improvement would be to provide a more systematic form of advice to authors than the present system of criticism and comments from colleagues. There is a strong case for an occasional refresher course to practising scientists to develop their skills in writing for the popular press or in oral presentation of scientific information to the general public.

Publication of research findings in a scientific journal, although the end-point in one part of the communication system, is just the beginning in another part. Once research has been completed and the findings reported, the information needs to be reissued in a variety of different forms which can be understood by all who are concerned with using its results.

There are two kinds of publications that cover this wide range of readership, the technical article and the scientific article. The technical article is an organised presentation of facts and data to inform, educate, and assist readers in the performance of their jobs e.g. plant or process description, operating procedures, management techniques. Its purpose is to increase the reader's specific knowledge. Scientific articles are directed at readers who are seeking to increase their general knowledge about a subject, whether this be things, theories, or persons e.g. Scientific American, New Scientist, Science Journal.

Among the difficulties in writing for the popular press are those of knowing how far one can use scientific terminology, and how much detail to include. Thus apart from being able to understand the significance of the scientific information, the writer must be able to impart that information in terms understandable to the readers and in a style appropriate to the particular newspaper. It is this failure to understand the science reporter's difficult task that sometimes causes so much antagonism and suspicion among working scientists, leading to charges of misreporting and distortion of facts.

The Training of the Science Communicator

From what has been described above, communication is a two-way process that involves producing, transferring and receiving information by means of the spoken or written word or by visual illustration. Thus before one can communicate effectively one's mind must be clear on what one wishes to communicate, with whom, and for what purpose, and with what response in mind. In addition, one should know the best mechanism for communicating to a particular target group. Thus while one need not be a scientist to communicate information with scientific content, an effective communicator of science must have good understanding of the subject matter and must be able to impart information in terms understandable to an audience within a particular cultural setting. The type of training required by the communicator then depends on his or her own educational background, the medium of communication, and the target audience.

To provide scientific literacy among school pupils, science should have a place in the initial and in-service training of <u>all</u> teachers. In addition to the broad knowledge of the subject, teacher education programmes (at varying degrees, depending on the level in the education system for which teachers are being prepared) should be designed to include:

a) relatedness of science with other subjects in school curriculum

b) scientific talking (wherever possible this should be done not only in English but in the mother tongue also)

c) scientific writing (including writing in the mother tongue)

d) other forms of communication such as drama and visual communication.

In this respect, the course in scriptwriting for the production of educational radio/TV programmes for mathematics and science education at RECSAM (Regional Education centre for Science & Mathematics, Malaysia) is an example of what can be done in in-service courses for teachers. The course content includes:

a) understanding of the principles of using radio and TV programmes for educational purposes;

b) exposure to the techniques for the production of radio and TV educational programmes;

c) planning for scriptwriting;

d) techniques and procedures in scriptwriting.

It is suggested also that whenever practicable, teachers especially those in secondary schools, should be seconded for short periods to experience some aspect of science in the world of work i.e. in manufacturing industry, research, agriculture and medicine.

Bearing in mind that the very small number of personnel presently communicating science in Africa have little or no background in science, what training is required for them? Perhaps what could be very useful is short-term exposures to experienced science communicators in the field. These exposures could be in the form of lectures, seminars and training courses. It should also be recognised that there is at the moment very little incentive for scientists to become communicators beyond their peers. For popularization of science to make a useful beginning in many countries in Africa, every effort should be made to orientate and involve many of them in mass communication to reach the various kinds of users of scientific information; and such efforts should be given due recognition. Popularization of science should not be treated as if it were secondary to research; dissemination of research results is as important as research itself. Furthermore, in popularizing science competence in mother tongue (local language) is a tremendous asset and training should be available to enhance capabilities in this skill.

References

[1] OECD, Organisational Problems in Planning Educational Development, Paris 1966, p.84.

[2] Ingle, R and Jennings, A, Science in Schools: Which Way Now?, University of London Institute of Education, 1981.

[3] Ingle, R and Jennings, A, ibid. pp. 99-100

[4] ibid., p. 100

[5]Commonwealth Secretariat, Report of the Eighth Commonwealth Education Conference, London 1980.

[6]Commonwealth Secretariat, The Interrelationship of Science, Mathematics and Technology Education as a Basis of General Education for All London 1985.

[7]Science Policy Foundation Change, No.2 1984, London.

[8]Commonwealth Science Council, Communication Techniques Workshop, London 1976.

[9]Ingle, R and Jennings, A op. cit.

CHAPTER 3: MECHANISMS FOR POPULARIZATION OF SCIENCE

Dr. Andrew Salisbury, School of Education,
University of East Anglia, Norwich, U.K.

1. Popularizing Science Through Formal Education

Two incidents

I was in an African primary school a few months ago where a standard 6 class were all working on questions about the 24 hour clock. During the lesson I began going round to help the children with their problems. It was not long before the teacher asked me to teach the whole class of sixty or so children. In fact the very competent and welcoming headteacher who was showing me round the school was in the room at the time and remarked, "oh good! I've always wanted to know about the 24 hour clock, I've never really understood it."

As the lesson developed it emerged that only one child in the class had a watch - and that this watch did not operate on the 24 hour system! Now I pride myself on giving quite good lessons usually - and I hope that this was no exception. But I was left with feelings of disquiet. I keep asking myself whether these children need to know about the 24 hour clock, especially as early as standard 6 and I continually come to the same answer. No. They don't need this. The headteacher certainly managed her private and professional life without it and I doubt whether it should be part of a core curriculum. I am suggesting that there are many areas and topics in science which should be subjected to the same query. Is this useful to children? Will it be useful later? Is it an appropriate use of school time to deal with this topic? Is this topic being taught by the most effective and efficient means? More importantly, is this science topic useful outside school? Would it be valuable if the children tried to explain it to others outside the school? How and why would it be valuable? Is it part of a scientific education worth popularizing? Judged on such criteria much of our science teaching may be of limited value.

A second incident was mentioned to me last month. An earnest and hard working teacher in a school was dealing with disease. The teaching was based on a class text and the teacher was intent in developing the central message that disease can be spread by various agencies. All the children were listening intently. The classroom control and the actual teaching were both good. It could be considered that all was under control with both good teaching and real learning taking place.

Now many of the children in this school came primarily because of the school dinners. A daily food ration was available. Many of the children were also in the habit of taking half of their food home for other children in the family.

By now you will have guessed that the food was uncovered except by a multitude of flies. The teacher stressed that flies were a major carrier of disease but did not make the obvious connection with what was happening in the classroom.

The relevance outside the book learning situation was not made. There was an enormous gap between theory and practice, and between rote learning and application. It is not only important what we teach but how we teach it. There is no way in which it is possible to popularize science if the teacher does not see the need to think of real applications and to see science as a possible way of manipulating the environment.

Formal School Science

In the present day world and in the immediate (and long term) future we may take it as self evident that every child's education should contain some science. The time allocation for science is, of course, a matter for debate. The sort of science (or sciences) also requires consideration as does the many problems involved in deciding strategies for more effective teaching methods. It is also necessary to consider the interaction between the demands of science as a discipline and the demands of society, the community within which a child's scientific education takes place.

There is a further question to be asked about the nature of science. To what extent should teachers be committed to an academic view of science as a field of knowledge, or is it reasonable to have science as a series of unrelated experiments (which do not "hang together" in a structured way)? How many of us have done experiments merely because they are exciting rather than for their intrinsic value?

It is easy to formulate such questions but there is a purpose here. These questions need to be asked because they influence our thinking about the matter under present discussion. How can formal educational institutions best bring about an improved public awareness of scientific knowledge and of scientific processes?

To make this paper easier to follow, I have taken the themes of primary schools, secondary schools, and teacher training. Much of what I say will be appropriate to all these themes.

2. Popularizing Science Through Primary Schools

Let us come down to earth with a bump. What should be the aims of primary science? How can these aims include effective dissemination outside school? Consider a typical and unpromising case. How can primary teachers deal with science when:

a) they have little in the way of a scientific background;

b) they have virtually no resources for the subject; and

c) there is hardly room for the 50-70 children in the class?

"With difficulty" you may reply! More to the point in the present context, how can such teachers influence scientific understanding in their local communities? Such teachers may have no desire to teach science and can point to the difficulties under which they

teach to justify the absence of real science in their classrooms.

Teachers with limited scientific backgrounds may consider the placing of science in the curriculum as an imposition, as something to be avoided whenever possible. Moreover, they may see such an imposition as a threat to their professional expertise and as an irrelevance in the earlier years of children's education.

Of course the situation is not always as daunting as this. Many schools have teachers with interests in teaching science and some have resources, others perhaps have fewer children in the classroom or laboratory. Some good work is being done. My point, however, is that even in the most unpromising conditions, similar to those I have outlined above, it is possible to achieve some scientific objectives, it is possible to popularize science, and it is possible to have some influence on scientific awareness within the local community.

It is, however, important that we do not expect too much too quickly. It is essential that we do not dismiss the difficulties, but that, knowing the difficulties, we work towards easing the problems for the hard-pressed, scientifically diffident, primary teacher. Okeke (1984) suggests a way forward in the latest CASTME journal, suggesting that traditional games and play activities can be integrated into primary science education programmes.

Primary Science in England

A change is creeping through the English primary education system as it relates to science. These changes are coming about because some of those interested in curriculum development in science are emphasising the importance of matching children's intellectual developments to the types of primary scientific education the children receive. There is an emphasis on the study of how primary children may best learn (rather than teachers teach) scientific ideas.

Primary science teaching is also being promoted by Her Majesty's Inspectorate (that is by Government educational agencies) especially the Science Committee. Local education authority advisers (these are officials employed by regional educational organisations on a subject basis, Science, English, History and so on) are also pressing for science to be an essential ingredient of primary education. Many are producing excellent guidelines for the scientifically gauche teacher. Has anyone invented a word for lacking in scientific aptitude similar to illiterate or innumerate, perhaps a-scientific?

Inservice teacher training in science is taking place in universities (including the Open University in which students study at home receiving their study materials through the post and by radio and television) and Colleges of Further and Higher Education. This is organised in a variety of ways including short courses (some sponsored by the Department of Education and Science); longer Diploma courses; courses leading to B.Ed degrees often on a part-time basis; and Advanced Certificate and Masters' degree courses in Science Education. In the University of East Anglia we have such courses with most of them emphasising inter-related mathematics and science. Other interesting and potentially highly valuable help is available to some teachers through school

based in-service work both on a casual basis between concerned teachers, and on an official basis through the use of College and School of Education staff as visiting teacher advisers. Again, the University of East Anglia has been in the forefront in such school-based in-service primary science (and mathematics) education (Salisbury, 1984).

All these activities have given science a higher profile in the school and have potential value in popularizing science outside the school. Primary science is seen as being an essential part of a child's learning about his environment. It is also being strongly argued that science at this level should not be a mere accumulation of facts but instead should emphasise the nature of scientific thinking, that is, it should highlight the processes involved in learning science. The main reason for an emphasis on process is that these are more likely to be used again in different situations and contexts.

Modes of Scientific Thought

Scientific thinking involves the following activities, though I expect your list would be a little different from mine.

a) Observation of happenings in the environment

b) Realization that problems require study

c) Identification of problems

d) Choice of a single problem for further consideration

e) Search for a pattern (possibly using data collection)

f) Communication of ideas
(including discussion between pupils and teacher)

g) Design of experiment
(possibly with teacher guidance using children's ideas and interests)

h) Experimentation (especially the testing of hypotheses)

i) Explanation
(suitable for the ages and understanding of the children) and

j) Application
(immediate classroom relevance and long term community needs)

These modes of thought will be discussed later in terms of a practical activity. It is asking too much from young children to expect them to be involved in so many aspects of scientific thinking. But it is possible to make a start. It is possible, indeed it is essential, that primary children are involved in a variety of ways of thinking scientifically.

Young Investigators

These modes of scientific activities and thinking may be illustrated by the British Association for the Advancement of Science Scheme: Awards for young investigators (BAYS, 1983).

This is a scheme designed to popularize science amongst young people in Britain and it has had a spin-off in terms of publicity for science as an activity rather than as a body of knowledge - it emphasises process rather than product.

The objectives of the bronze awards (there are also silver and gold) are interesting and provide another framework within which to consider how science should be taught and more importantly how it should be learnt. They are intended to help young people learn:

a) skills and care in the manipulation of tools and materials

b) to be patient and keep records

c) to tabulate data and use tables

d) to apply different methods of measurement and investigation of properties of living and non living things

e) that the ways in which materials are used are influenced by the properties of the materials

f) to predict the effect(s) of certain changes through observation of similar changes

g) to observe objectively

h) safety precautions

i) to choose suitable means of recording observations and the expressions of results and

j) that more than one variable may be involved in a particular change

I now put forward a suggestion for our hard-pressed and scientifically limited teacher. Of the many examples I could have chosen, I have picked the following one on the study of soils and rocks in the school locality.

It is taken in an amended form from Matsela (1982). Briefly he suggests that pupils should:

1 a) collect rocks and soils

b) study their external appearances and textures

c) discover whether they absorb much water

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2 a) tour the school surroundings

b) look for special features e.g. fallen boulders, dongas etc.

c) discover how the features were formed

3 a) classify a rock and soil collection

b) give name, appearance, hardness, structure, water absorption and uses

4 a) consider soil and water conservation

b) study erosion, drainage, windbreaks, tree planting etc.

5 a) experiment with fertilizers

b) build compost heap, apply various manures to trial plots

c) discuss properties of super-phosphates, wood ash and other fertilizers.

It is left to the reader to decide on the appropriate modes of scientific thinking used in each of these activities.

As has been said by others before him, Matsela (1982) asserts that "proper pupil-activity is the key to the children's learning of science".

> "Primary school science should essentially be practical and easy enough for the children to understand, enjoy and apply, while at the same time it whets their love and interest, widens their outlook and helps them to improve themselves and their surroundings. It is very important that children be allowed to make observations and deductions as far as possible uninterrupted but guided skilfully. The value of pictures, illustrated charts, nature-charts, specimens, nature excursions, etc., will prove profitable in the hands of a conscientious science teacher. A teacher who always stands before a passive, silent class to deliver a sermon-like uninteresting and incomprehensible science lecture should, for the good of the child, be a thing of the past in our primary schools. Science in the primary schools should meet the needs of the primary school child.
>
> If Primary School Science will awaken our children's latent interest in plant and animal life, as well as catch their attention and train them to be themselves in any environment in which they are, and attract, encourage and foster investigations into some simple aspects of common phenomena and into soil and water conservation, it will have done much. If it will assist children to adjust easily and comfortably to their surroundings and to influence and improve the latter, it will be achieving its most essential purpose. According to the Lesotho Syllabus for Primary schools our objectives in teaching science are:

(a) to give children a real understanding of what is meant by scientific method. This is essential for many children are full of fear and superstition. (b) To show the children that events taking place in the world around them do not happen without cause. (c) To teach the children to observe what they see around them, and to be able to describe in simple language what they see. (d) To lead children to a careful assessment of the data placed before them. It is important in all spheres of life to cultivate the attitude of not jumping to conclusions unless there is sufficient real evidence for those conclusions. (e) To satisfy the children's curiosity concerning the reasons for certain happenings in the natural world in which they live. (f) To give useful knowledge which may be used in the solution of one problem or another. Teachers should bear these objectives in mind. It should also be borne in mind that children do not see the things are learned as separate units but as a whole. This suggests the value of integration of Science with the other Primary School subjects."

2 The subject with which science should most closely be linked, I submit, is mathematics. It is my belief that it is only by linking primary mathematics and science (where it is appropriate to do so and it is not always so) that we will see any improvement in the situation - and hence any real popularizing of science. Mathematics is regarded rightly as an essential component of any education. But mathematics teaching can be a very sterile diet of sums and more sums. Without practical activities and a sense of investigative adventure it has often little application outside school. With a bias towards the solution of real and relevant problems mathematics learning can come alive. Primary teachers' attitudes towards science can be radically improved by an emphasis on relevance and popularization.

So the use of scientific investigations and the forming and testing of numerically based hypotheses adds a vital and enriching dimension to mathematics. Equally, science is an essential part of a primary education when it is seen to help illuminate mathematical ideas. For too long the disciplines of mathematics and science have appeared to be in conflict because of their essentially different natures. But when the two subjects are seen as essential props for each other then it becomes easier to insist on primary science.

Incidentally every class has one resource for scientific study - that is the children themselves. Now this does not imply that children are expendable - but there are some very good scientific studies which can arise from children studying themselves. These are available, for example, in the School Council, Science 5 to 13 Project booklet entitled Ourselves. I recommend this to you. Children are interested in themselves and it is good educational practice to start with children. (Rocks and soils should come later!) Children should then be encouraged to do a little experiment at home which involves others in the family. A very simple task could be set such as discovering how far away letters or symbols of a certain height can be read. "My mother could just read them at 15 metres, my brother at 25, and my sister at 28 metres." I commend the work of Alan Ward in the School Science Review to you but many of the ideas need considerable adaptation for African schools.

The theme of obtaining science from the children themselves can be a rich source involving mathematics as well as science. Children will gain an understanding of biological variation. It is possible to focus on the study of environmental problems and discussion can lead to studies of the head, the eye, arms, hands, fingers and finger prints, legs, feet, and footprints, and the whole body. Heights, weights, body area, breathing rates, the digestive system, foods, uses of the main body organs, skeletons and the uses of muscles, bones and skin are all aspects which are worth studying. It is also possible to study skills such as catching, throwing, reacting to certain situations, and performing certain operations. (How long does it take you to write your name ten times?) The comparison of two sets of statistics can lead to some valuable pictorial representation and mathematical graph work.

Now I think we can accept that a hard pressed primary teacher with little in the way of science in her/his formal education is unlikely overnight to become a scientific expert. It has been suggested that one of the tragedies of science is that, in many cases, there is a "high entry" requirement. By this I mean that it is difficult to get started scientifically. It is hard to "get into" scientific ways of thinking. Let me take an example. I can read books on history without my needing to have too many sophisticated ideas. But many historians would find corresponding books in science quite incomprehensible. There is a greater threshold of conceptual development required in science, though this should not be used as an excuse for not attempting anything.

The opposing view is encouragingly put forward by Medawar (1984). People, he suggests, who want to understand the gist of science can do so. In any case, he maintains, the ideas of science are quite simple. It is the scientific 'performance' rather than the scientific 'conception' that tends to bewilder. The implications in popularizing scienc are evident. It needs to be emphasised that science at its simplest is one way in which we make sense of the world in which we live. At this level it is accessible to everyone including young children - as such it has an intrinsic interest for all. This is science made popular. Learning science with children is quite feasible when teachers are given the confidence to try. Scientific knowledge grows with use. Trying to learn and to teach by rote will not, as this provides a sterile education for teachers and for children.

How can such primary teachers be supported in their quest to teach science? First, there should be the support and professional guidance of other teachers. What needs to be avoided is the hiding of one's ignorance. Discussion of problems and a professional desire to succeed can solve many problems. Such professional links should be supported and fostered by those organising the provision of schools. Unofficial and official professional organisations can also help. It is essential that local Science (or preferably science and mathematics) Teacher Associations are set up and maintained. Many places will already have similar organisations which provide mutual help and support. Often these are kept going by the enthusiasm of one or two dedicated teachers. These can sometimes be the best associations but support can be necessary to help some of these associations along by encouragement and by financial aid. Of course the links made between staff of various schools need to be forged with care and sympathy but if science teaching is to be widespread in a

community these associations are, I believe, a vital link in the popularization of science.

A primary teacher embarking on a piece of science should ask questions such as the following:

a) Will this use scientific processes?

b) Which processes?

c) How can I ensure that the children are involved in scientific thinking?

d) Will it motivate them?

e) Will children be able to explain to their families what they have been doing?

f) Will they be so excited about their science that they have to tell their families or friends?

Primary science is full of richly rewarding learning situations. Never mind the book learnings, nor the recall of factual information, let us give children a taste of being young scientists even if they do not take their study of science any further.

3. Popularizing Science Through Secondary Schools

I have dealt at length on primary aspects because

a) I think the need is greatest there

b) secondary science should be like the sort of science I have outlined for primary children.

Hence it is possible for me to deal with secondary science more briefly. Last month, "Science 5 to 16: a statement policy" (1985) was produced in Britain and calls for a radical reappraisal of science teaching. The "factual and theoretical content of many existing courses will need to be sharply pruned without reducing the intellectual demands made on pupils". All pupils should be introduced to the main scientific concepts, skills and processes and to the technological applications and social consequences. I believe the message is there for Africa as well!

Nevertheless, at the secondary level things are a little different. It is obvious that science books and science apparatus are an essential ingredient of science teaching in the secondary school. An interesting account is given in the CASTME journal (Mzungu 1984).

Balance and Assessment

Here, I would suggest, a radical rethink is necessary. Again teachers need to think about the scientific diet they are providing. Is it balanced in terms of biology, chemistry and physics and other areas such as geology? The mineral wealth of Africa should not be ignored and science and technology should popularly be seen as ways of exploiting such wealth. Is such a

balance essential? I would suggest that this need not necessarily be the case. There is the same danger in African countries that we have in the United Kingdom. That is, the curriculum has been determined by the requirements of an externally imposed examination system. Now is the time to strike at these constraints. In the U.K. an announcement was made recently on the ways in which the present GCE O level and the CSE examinations are to be combined into the GCSE General Certificate of Secondary Education. This is more than a cosmetic fusion of the two separate examination systems. There is a radical rethinking going on about the nature and style of assessing children's abilities. The main thrust is that of providing examinations 'from the bottom up'. The educational needs of the child of average, and below average, ability must be considered. Additionally, there is a danger in developing countries that children become scientifically alienated from their families. It is my belief that this is counterproductive. It should and must be possible to teach secondary science so that children see the value in talking about science to their parents and friends. If children become scientifically arrogant then it is probably the fault of their teaching. A main aim of the science teacher should be to search for ways of popularizing science in the locality. How many do so and how can we best foster this aim? Mechanisms do exist. Museums can be rich sources of scientific ideas. This is proposed strongly by a member of the CASTME Council, Professor Arthur Lucas (1983). Indeed for the scientist the whole world is surely a large scale museum? Another way in which schools can be involved in popularizing science is through the setting up of scientific exhibitions and science fairs.

An extension of the science fair idea is the Commonwealth Association for Science, Technology and Mathematics Education (CASTME) Awards scheme. These awards are open to all teachers of mathematics and science and technology throughout the Commonwealth. A teacher or group of teachers who have produced an interesting innovation in their classrooms are warmly invited to enter this annual award scheme. We all hope there will be a flood of entries from Commonwealth Africa in the years to come.

Links with Industry, Commerce and Agriculture

This area is full of difficulties. Local industries, commercial firms and agricultural practices will vary tremendously from country to country and from community to community and it is impossible to generalize about ways of forging effective links between schools and industries. In Norfolk, U.K., we have a scheme whereby a local secondary school and a local firm adopt each other as partners. I commend this to you. Those in local industries should be encouraged to talk about their needs for skilled labour, their views of how schools should be generating a scientifically aware community. Such dialogues can be very productive for all concerned. Do not be afraid to make such contacts. Both partners may be both surprised and delighted at the responses which are forthcoming.

4. Popularizing Science Through Teacher Training

Lastly, I come to teacher training. Here again I believe the message should be much the same. It is not the responsibility of the teacher training establishment to attempt to make up for the deficiencies (or supposed deficiencies) of secondary schooling.

It is unfortunate that much primary teacher training is in the hands of ex-secondary teachers. There is an in-built tendency to teach the subject rather than the problems of learning and teaching science. I suggest that it is probably counter-productive to attempt to reteach the secondary syllabus or even to attempt initially to extend primary student teachers' knowledge in a particular subject area. This tends to have the effect of confirming students' poor attitudes and reinforcing their poor self-concepts. What they really need is a very thorough grasp of the principles of elementary scientific ideas. They especially require help in determining children's thinking patterns. Apart from acquiring the usual skills of classroom organisation for teaching, it is necessary to have also skills in organising children's learning. Student teachers should be given help in promoting discussion in the classroom between pupils and the teacher and between pupils themselves. Without discussion there can be no communication and without communication there can be no popularization. They also need to be able to diagnose children's abilities and difficulties in science. Problems in teaching and learning scientific skills and processes need to be discussed with student teachers. Part of their training should focus on the classroom problems and this entails visiting local schools in order to teach, listening to other teachers teaching, and should involve the tutors operating in front of their students in the primary classroom. Once student teachers feel that they are able to cope with some form of science teaching then it may prove possible to take them on from their present level of abilities towards more sophisticated teaching patterns. A way which I commend to you is that of using the student teacher as a mini educational researcher. For example, how do children think about the concepts of volume, force and pressure at various stages of their development? Teacher trainers should raise these sorts of issues with their students. Then, with their students, teaching material should be developed for use with a few (about five or six?) children in a nearby classroom. This should be followed by debriefing sessions as students relate their experiences and difficulties and in which an analysis is made of the learning difficulties in a topic. Strategies should be suggested for attempting to overcome some of the inherent problems. Such activities are highly motivating for the students. It is by such or similar methods that they acquire an understanding of children's abilities at various stages. Students are thus being real researchers in the tradition of, for example, Piaget, Dienes and Bruner. Teacher training has a long way to go before it can be considered really effective.

5. Conclusion

Lastly I wish to end with three quotations. One from the Bible is "If the vision fades the people perish." We need to have a vision of what science education and the popularization should be. The other two are more misquotations, one respectfully from Martin Luther King and the other from the musical "South Pacific." "I have a dream", a dream in which attitudes to science may change, a dream in which all children receive an exciting, relevant, and fruitful scientific education, a dream in which all children become aware of the values of science as an influence in society, and a dream in which they can transmit this awareness to others. Why do I dream? Because in the words of the song "if you don't have a dream, how you gonna have a dream come true?"

Bibliography

Ambrose, B.R. & Baker, R.E., 1980. Primary Science: Ten Lessons. School of Education, University of East Anglia.

Ambrose, B.R., Baker, R.E. & Salisbury, A.J., 1980. Primary Science: Ten more Lessons. UEA.

Ambrose, B.R., Baker, R.E., Denny, M. & Salisbury, A.J., 1981. Primary Science: Another ten Lessons. UEA.

Ambrose, B.R. & Baker, R.E., 1983. Primary Science: Ten Electrical Lessons. UEA.

Association for Science Education, 1981. Applications of Science and Mathematics to Industry and Technology, ASE.

Baker, R.E. & Salisbury, A. J., 1981. The High Suffolk Programme: Professional isolation and curriculum change in rural schools. Commonwealth Association of Science and Mathematics Educators.

Bradley, H.W., 1976 & 1979. A Survey of Science Teaching in Primary Schools. School of Education, University of Nottingham.

British Association for the Advancement of Science, 1983. Awards for Young Inventors. British Association of Young Scientists.

Cockcroft, W.H. (Chairman), 1982. Mathematics counts. HMSO.

Department of Education and Science, HMI Science Committee, 1983. Science in Primary Schools. D.E.S.

Department of Education and Science, March 1985. Science 5 to 16: A statement of Policy. HMSO.

Education in Science, various. Journal for the Association for Science Education.

Hart, K. & Turner, A.D., 1981. Mathematics-Science Links in the Secondary School. Mathematics in School.

Lucas, A., 1983. Scientific literacy and informal learning, Studies in Science Education, 10 Layton, D., (Ed.) University of Leeds UK.

Matsela, Z.A., 1982. Primary Science Activities. Mazenod: Lesotho.

Madawar, P.B., 1984. The Limits of Science. Oxford U.P.

Mzungu, P.A., 1984. Report on a trip to SIM-SCI, CASTME Journal 5,1.

Okeke, E.A.C., 1984. Integrating traditional games and play activities into primary science education programmes. CASTME Journal 5,1.

Salisbury, A.J., 1984. Inset School-based Provision in Mathematics and Science in Rural Primary Schools. Paper presented at the British Association for the Advancement of Science Annual Meeting held at the University of East Anglia, Norwich, UK.

Schools Council, 1972 onwards. Science 5 to 13 Project. Macdonald.

School Science Review, The Journal of the Association for Science Education. College Lane, Hatfield, Hertfordshire, UK.

CHAPTER 4: POPULARIZATION OF SCIENCE THROUGH THE MEDIA

Ms. Jerusha Castley, Journalist and Broadcaster

Introduction

Many books have been written on communications in recent years, and a number of these have focused on radio, television and the press. This paper will attempt to discuss how each of these three means of communication can be used to popularize science in Africa.

For any one interested in communication, Africa is an exciting field of study because all the modes and varieties of human communications are to be found there - the traditional ones like music, art, dance and oral literature and the new technological forms like television, radio, telex, the telephone and the computer. The social science student in the West is not as fortunate as his African counterpart because it is almost impossible for him to imagine life without the modern mass media; it is difficult for him to stand back and assess what role these play in social, economic and political life. For the student in Africa, however, the situation is different. Many of us remember television arriving in our town or area, some of us may remember the coming of the radio and some members of the older generation may remember the first newspapers.

A number of factors must be borne in mind when exploring ways of popularizing science through the mass media in Africa. First, the mass media cannot replace other forms of communication, and there are limits to what they can do. In Africa these inevitable limitations are made even more restrictive because of the way the media are run. In most African countries, the media are centralised. They are established, supported and staffed by the state. Governments often appear to see the media as being of considerable importance in exercising power. Thus news media which are capable of reaching an audience without having to depend on national governments, may be seen as a threat to the existing power structure. This is partly because the mass media do not just provide new means of achieving the same end; radio, television and newspapers actually introduce new relationships, new concepts and new ideas. The mass media have the power to address directly a large scattered audience. Through the mass media information can be transmitted across all social and political barriers. But, in practice, access to the media is not without its limitations. It is neither equal nor free. The control of the media is generally in the hands of those who already have political power. There are also restricting factors among the audience; the first people to own radio or television tend to be those occupying positions of power or prestige within the existing social structure. Of course, this situation is changing, thousands of people without any formal education, and thousands of people with no important political positions have access to the radio today.

It is also significant to note that the communicators in many African countries are mainly government employees and they necessarily communicate information endorsed by the government. In my experience there is little feedback from the general public, and there is the danger that mass media may increase the already

widening gap between rural and urban life. It is in towns that most journalists work, it is there that radio and television programmes are produced, and it is there that newspapers are printed.

Science and Journalism

Interest in science is increasingly growing among the general public; and journalism has to be aware of this phenomenon. This interest in the development and achievement of science comes from both the positive and the negative social effects of science. Many welcome scientific discoveries, like penicillin or protective vaccines. But there has also been some destructive inventions like the atom bomb or certain pesticides. People hear about or experience some of these scientific developments and they want to know more about them. The information they want cannot always be explained by scientists and other experts, since it should be conveyed to a large lay public in a non-technical language. This is where the skills of a science journalist comes in. He has to communicate to a vast majority of the public which is unfamiliar with scientific symbolism or even the basic concepts of science.[1] This makes the task of a science journalist a difficult one, and doubly difficult it he happens to work in Africa because journalists and broadcasters there tend to be young and inexperienced. Most of them have very little or no background in science. The best tend to leave the profession for more lucrative employment elsewhere.

The task of a science journalist in Africa is to interpret science to people who appear not to recognize the importance of science in their daily lives. The general attitude of the majority of the lay audience is that science is difficult and remote. Many factors have contributed to this attitude towards science. Historically, the colonial governments in both Anglophone and Francophone Africa required minor white collar workers like clerks and interpreters, and so the educational systems tended to lay more emphasis on reading, writing and arithmetic at the expense of technical and science subjects. The emphasis during the immediate post colonial period in Africa, was on the spread of literacy and the need to produce skilled personnel to take over jobs previously done by expatriates. Therefore most of those who had some scientific training took up managerial and administrative posts. Over the years science became a neglected field with very few students pursuing the subject. Also teachers in general did not encourage those who were weak in mathematics to study science even when some of these showed interest in the subject. Moreover, the screening of students into arts and science streams in schools was done much too early. This early screening alienated a great number of students. It stifled interest in science. Regrettably no one thought of rechannelling this early interest in science.

Science Reporting

The lack of scientific training of most journalists in Africa probably accounts largely for the very little coverage of science and technology-related news items in most newspapers in Africa. And the little that is reported is mainly about scientific achievements and happenings in the developed world. Yet there is so much in Africa that could be reported upon the national press e.g. agricultural and medical research findings and environmental

issues. As a matter of interest, I decided to monitor science reporting, for a period of one week, in national newspapers in four African countries and below are my findings:-

Daily Times of Nigeria: Lagos

21/3/85 Conservation strategy for Nigeria by a Nigerian journalist.

22/3/85 15 die of meningitis. Straight reporting, no attempt to explain causes, symptoms or cure for the disease.

25/3/85 Health planners grope in the dark. Economic Development through Agriculture.

27/3/85 Problems of Nigeria's monoculture economy.

The Herald, published in Harare - Zimbabwe

16/3/85 An item on New Soviet techniques to cure blindness. An item on an American vasectomy father whose wife was expecting sextuplets in Maine, U.S.A.

17/3/85 Nothing on science

18/3/85 Nothing on science

19/3/85 Fake antibiotics dumped in Africa - from a London correspondent.

20/3/85 Nothing on science

21/3/85 Robots steal the show at Japan's Science Fair - Japan. Researchers stumble on cancer miracle drug - French researchers in Noumea.

22/3/85 Soil survey.

The Standard: Nairobi - Kenya

19/3/85 Health article about one's blood group.

20/3/85 New sugar cane process to convert sugar cane juice to ethanol. Research done in Australia.

The Standard: Nairobi - Kenya

21/3/85 Small article on rabies.

22/3/85 Nothing on science

23/3/85 Nothing on science

Times of Zambia

(I had difficulty getting a complete week's newspapers from London)

15/3/85 Nothing on science

16/3/85 Nothing on science

17/3/85 N/A

18/3/85 Nothing on science

19/3/85 N/A

20/3/85 Nothing on science

Of course no one can claim that this is a representative sample. It does, however give a rough idea of the importance placed on science reporting by the countries quoted. There is definitely room for more science writing. African science journalists must start writing more about what is happening around them. Their lay audience will identify more with issues relating to agriculture, health and environment. But science writing must not be separated from the rest of the writing in the national press; because to have just science journals and science magazines might alienate the lay public. Science writing and reporting must be integrated with the rest of the national and international news. This will make science more accessible to those members of the public who do not see themselves as being interested in science. But without the necessary skills a science journalist cannot present science attractively enough to the general public. It is necessary for future and potential science journalists to be exposed early enough to proper techniques for effective communication. This is probably where schools' broadcasting could play an important role. Apart from just listening to the programmes, pupils could be given the opportunity to discuss factors that make a programme good or bad. Schools of journalism too could offer students specific science courses.

The Role of the Scientist

Effective science communication can also be achieved if we involve the scientist concerned. At the moment there is not enough awareness among our African scientists about the role they can play in popularizing science. Where possible, scientists must be encouraged to write popularly about their subjects in the national press. Universities must encourage their scientists to simplify their learned articles (written for the academic journals) and then publish them in the national press. They should do this without feeling that they are demeaning their profession. The African scientist has an obligation to popularize his work. The tax payer who has made it possible for the scientist to do his work, is entitled to know what is going on in science and technology. Every scientist has a duty to inform his society.

The scientist should also be encouraged to participate more actively in producing science programmes for both radio and television. There should be room for them to take part as programme advisers and probably even as presenters. If scientists are involved in this way, they would have a better understanding of the media and this would improve the media's coverage of science and technology. This would also bring the scientist and his subject closer to the community.

The Relationship between the Journalist and the Scientist

When making science programmes or when writing science articles for the newspaper, both the journalist and the scientist encounter various problems:

There are times when the scientist and the journalist have different concepts about what should be reported either in the newspapers, on radio or television. The journalist may want to simplify the scientist's work in a way that would appeal to the lay audience - but the scientist may demand precision and a fuller, maybe more complicated, approach. This might create suspicion and lack of co-operation thus making the scientist reluctant to deal with media personnel.

There is also the problem of defining the role of the media. The scientist may want to inform and educate the audience as well as promote science. But the journalist may be interested in entertaining his audience. This problem can be overcome by discussing in advance the nature of the programme or article, so that both parties know precisely where they stand.

Who has the final say about what goes out to the public? Sometimes scientists demand total control, otherwise they refuse to be interviewed. While some scientists may tell you only what they think is important, it should be pointed out here that it is the journalist who best knows the audience he is catering for. If the object of the exercise is to promote and popularize science, then both parties must discuss what the final product is going to be. It is vital that an atmosphere of co-operation prevails.

Then there is the classic lack of understanding between scientists and journalists. Science journalists in Africa have little background in science and less familiarity with how research works. On the other hand scientists themselves have limited understanding of how the mass media work.

Popularizing Science through the Radio

One section of the modern mass media which is the fastest growing and the most cost effective is the radio. Compared to Western Europe however, radio took much longer to arrive in Africa. This is mainly because initially radios were expensive; they used valves which required high voltages which were best supplied by mains supply, a facility largely confined to industrialised societies. The invention, in 1948, of the transistor changed all this. Production started on a massive scale making radio commonplace throughout the world. Radio was brought to millions of people, and the growth of ownership of radio sets has been rapid even in the poorest countries. Radio has the ability to overcome the barriers of distance and illiteracy. In parts of Africa radio reached the remotest of places long before roads were built, and long before the provision of adequate telephone and postal services. Compared to television radio provides a better means of downward communication from the political centre to other parts of the country. The use of radio means that information can now be transmitted independently of socially structured layers of authority. Millions of people who hold no positions of social importance have access to radio. The New World Information and Communication Order proposed by the UNESCO MacBride Commission, gives priority to radio over television, and to local community press and radio - something greatly neglected in most African countries which have emphasised centralisation.[2]

In a survey carried out in November/December 1983 by International Broadcasting and Audience Research in Urban Cameroon, it was found that 85% of all the people interviewed had a radio set in working order in their homes. Ownership of sets was lower in the older age group and among those with no formal education.

Urban Cameroon November/December 1983

Ownership of sets

Has Set	No Set
85%	15%

Listening

Every day	Once a week	Less often	Never
74%	18%	4%	3%

This survey shows there is a regular audience in urban Cameroon of 92%. It is important to note here that the lack of a radio set in their homes did not prevent people from listening to the radio. They listened at a friend's or neighbour's house.

A similar survey was carried out in Kenya in July/August 1983 by the same organisation. It was found that 47% of the sample owned a radio; ownership increased with education and social class. Again lack of radio did not prevent people from listening.

Kenya July/August 1983

Ownership of sets

One Set	Once a week	Less Often	Never
47%	18%	9%	26%

Graham Mytton, then a Research Fellow at the University of Zambia's Institute for African Studies, carried out a National Mass Media Audience Survey in 1970-73. He found out that in Zambian urban centres 50% of the households had a radio set in working order, and 67% of urban adults were radio listeners.

In any attempt to popularize science in Africa, radio is the most effective tool because it is cheap; it has the ability to reach a larger audience, and there is a guaranteed audience. A good science radio programme must not assume that the audience has any pre-knowledge of the subject being discussed. When dealing with complicated scientific concepts, it is important to "hold the hand of your listener all the way", because the whole idea is to inform and educate people - not to turn them into scientists. Most radio programmes take the form of interviews and scripted information. When doing such programmes it is

important that the producer or the presenter understands the subject matter thoroughly, either through research or by discussing the subject with the scientist concerned. It is also important for the scientist to bear in mind that he is addressing a non-scientific audience. So it is important, wherever possible, to use simple everyday language. It is quite possible to do an interview without using complicated scientific jargon.

Some radio programmes may take the form of a straightforward talk. Here again plain, direct and colloquial language is more effective. Sometimes it is useful to write the script and then read it aloud to oneself simply because the way we write is not always the way we speak. What looks grammatically correct on paper may sound flat and boring when said aloud.

Popularizing Science through Television

This paper would not be complete without mentioning the role that television can play in popularizing science. The level of television ownership in Africa is less than that of radio. In Kenya for example, only 3%[3] of the people interviewed by the International Broadcasting and Audience Research, in July/August 1983, owned a set, and this was mainly in towns and among the better educated. However, television has made rapid advance in some countries, most notably in Nigeria, but in the 33 out of 50[4] countries where it does exist - it is chiefly confined to relatively few households in towns where mains electricity is available. Unlike radio, television, and to a lesser extent the national press, can and do, sometimes operate more as an extension of the media of the developed countries, portraying the ideas, values and cultures of rich societies. This is particularly true of advertising and the cinema. Some African television stations purchase as much as 80% of their transmitted material from non-African countries; and the irony of the situation is that the few broadcasting stations in Africa which can afford their own foreign coverage tend to send their reporters and correspondents to places already covered by the news agencies - New York, London, Paris, Washington or Moscow. For instance in 1982 there was only one resident African news reporter reporting for another country in Nigeria.

The technology required for a television station is complicated and expensive, and for African countries without the resources or expertise to establish or maintain such a costly communication system, the answer is usually to look elsewhere. Thus many African countries are forced to rely not only on western technology, but also on its films, television series, gramophone records and syndicated newspaper features.

This, however, does not mean that television has no role to play in popularizing science in Africa. In a sense it is probably a more effective tool than radio because one has the opportunity to use graphics and other visual aids when explaining complex scientific principles. The audience does not only listen and learn, but it listens, watches and learns; and I believe there is a case for introducing 'community' television in rural areas. Rural communities could gather in their social community halls to watch science and other educational programmes. The problems, however, one would encounter in putting this idea into practice are enormous. There is the prohibitive problem of cost, the

equipment has to be regularly serviced and maintained and a large part of rural Africa is not electrified.

Techniques for making television science programmes are fairly similar to those required when making radio programmes - in terms of respect for one's audience, clarity and simplicity of language. The main difference is that one is visual and the other is not.

Recommendations

1. It is important to create opportunities for established science communicators to improve their skills. For example creating an opportunity for a science journalist to spend some time at a research institution or at a university of science and technology. This has the advantage of:

   i) acquainting oneself with the areas of interest;

   ii) giving both the research scientist and the journalist an opportunity to work together and know each other;

   iii) enabling the journalist to improve his own technique for research.

2. Scientists must be given opportunities to interact with personnel from the media. This must begin early - they have the scientific knowledge therefore they must be encouraged to communicate this knowledge or if they are not good at communicating, they must be encouraged to have a positive working relationship with journalists.

   It is important that scientists are given training on how to write scientific articles for a lay audience. At every stage of their work and research, scientists should be encouraged to write press releases or publish articles in the national popular press. In order to learn the art of communication early, science students should be interviewed regularly during their training by science journalists - a two-way learning process. Perhaps it is not a bad idea to make it compulsory for every science doctoral candidate to give a popular talk or write a popular article about their work.

3. Research institutions should periodically send out newsletters about their work to the media so that the relationship between the two is maintained. These research institutions are maintained by public funds and so they have an obligation to publicise, educate and interest the public in their work.

4. Applied Science:

   The highest proportion of those studying science should be in the applied areas; and the students should aspire to all the specialities: technicians, technologists, experts in agriculture, physicians, engineers, managers and educationists. For this purpose, more technical

colleges are needed "rather than more ill-equipped, ill-maintained and badly staffed universities."[5]

5. African National Governments should initiate campaigns for popularizing science because the understanding of scientific and technical achievements is the best means of fighting against hunger, disease, natural disasters and pollution.

References

[1]Kirsch, Jeffrey W.: On a Strategy for using the electronic media to improve the public understanding of Science and Technology
In: Science Technology and the Human values No. 27 1979 p. 54

[2]Fish, J. P. Report on Community Radio; Rural Press Projects in Kenya 1983-4, Nairobi 1984

[3]International Broadcasting and Audience Research, London July/August 1983

[4]Mylton, G.: Mass Communication in Africa, London 1983

[5]Okogun, J. I.: Communicating Modern Science in Developing Countries in: Teaching and Popularising Science and Technology as Aids to Development UNESCO Interdisciplinary Guide 2nd Volume of the Blue Series Ed. A. Kornhauser J. G. Richardson

Bibliography

Ainslie, Rosalynde:	The Press in Africa, London 1966
Fish, J. P.:	Report on Community Radio, Rural Press Kenya 1983
Head, Sydney:	Broadcasting in Africa, Philadelphia 1974
International, Broadcasting and Audience Research, London 1983	
Katz, E. and) Wedell, G.)	Broadcasting in the Third World: Promise and Performance London 1978
Mytton, Graham:	Mass Communication in Africa, London 1983
" "	Listening, Looking and Learning - A Report on National Mass Media Audience Survey. Institute for African Studies, Lusaka 1974
" "	Africa Since Independence: Africa's Media Today and in the Future, York 1984
" "	Language and the Media in Zambia International African Institute; London 1978
Schramm, Wilbur:	Mass Media and National Development, Paris 1964
UNESCO:	Teaching and Popularising Science and Technology as Aids to Development. Ljubljana, 1984
Wilcox, Dennis:	Mass Media in Black Africa; New York 1975

CHAPTER 5: SCIENCE WRITING

Mr. Abdallah Ngororo, Director, Information Services
Tanzania

Science writing is a new phenomenon in our part of the world. So new that, often, most of the few science articles and programmes carried by our print and electronic media are contributed by foreign correspondents, news agencies and other sources exterior to our region.

There are few full-time media science writers; and newspaper space and radio/television time devoted to science is only a fraction of that devoted to politics, fiction, sports and many other subjects.

The scientific illiteracy among the general public, which is reflected in the media, is compounded by the problem of mutual mistrust and incomprehension between journalists and scientists. There are, thus, scientists who cannot write for the public and journalists who know no science.

Paradoxically, scientists and journalists are agreed that science and its practical sister, technology, have become part of everyday life. They also concede that science, which is both knowledge and a way of asking questions, is useful in helping to solve problems of hunger, disease, malnutrition, energy and many others.

It is this very paradox that sheds light on the theoretical convergence of interests of scientists and journalists. Scientists work on agricultural, health, nutrition and environment projects; they thus serve society and promote change. Journalists too are at the service of society; and they induce change. By informing and educating the public, journalists help promote agriculture through the disssemination of the appropriate information in an entertaining and factual manner.

However, instead of collaboration between journalists and scientists, there is mutual suspicion most of the time. Stereotyping has kept the two professions apart and has led to a communication barrier.

The science editor of Japan's Mainichi Shimbun in 1971, "is not a scientist. Yet, it is he who does what many scientists cannot do or do not want to do - to report in the general public's language the progress and potential of science and medicine".

We are in the right direction if we consider science writing as describing how a process works. This, in turn, compels us to ascertain that the reader will understand it as clearly as we do.

Science writing is based on the principle of leading a reader, who knows nothing, step by step, to a grasp of the subject. Once this is understood, science writers must remember it in every article that they write.

Let me ask you to imagine science writing as an inverted pyramid. Start at the bottom with the one fact that a reader must know before he can learn any more. The second sentence widens what was presented first, making the pyramid wider, and the third widens the second. Thus, gradually you can advance beyond mere fact into significance and speculation.

There is no limit as to how broad the inverted pyramid can become, but the reader will understand the wide implications only if he starts with a narrow, single fact.

We can demystify science and be on our way to acquiring the skills of science writing by helping the reader to identify himself with the scientific work being done. Therefore, always look for the human aspect by making use of your own experience to connect the reader to some mechanism that also touches his life.

Another way of helping the reader to understand unfamiliar facts is to relate them to sights that he is familiar with. The abstract principle can thus be depicted as an image which can be visualised.

Another way of making science accessible and comprehensible is to write like a person and not like a scientist.

Instead of the style of dry pedantry that is often associated with science, writers should use good fresh, and economical language. They should write clearly and without pretence, using vivid images from the vocabulary of everyday life.

The same principles of science writing apply to any field where the reader must be led across terrain that is new and complex: finance, energy and ecology. Numerous complex professions and new technologies await the writer who can describe them clearly. Only through clear writing can the rest of us think about our future and make educated choices in areas where we have little or no education.

Let us now turn to the question of handling scientists as SOURCES. Some scientists are willing to spend the time and take the patience to explain their work to a journalist fumbling for the facts. More than occasionally you meet the opposite type: the scientists with the cool and, even, cold attitude. Such scientists have been "burned" by the press. That is, some previous journalists have made some gross errors in describing the scientist's work, or exaggerated one aspect, or wrongly applied some aspects from, say, animal research to the human situation.

Every journalist, in contacting a news source, enters into an unwritten "social contract" from which each party expects something to his advantage. The journalist wants a story; the scientist might wish his work to be better known. The journalist wants a story; the scientist might see in that story an opportunity to educate the public, or to obtain more funding, or to advance his career, or merely to talk about his work with someone who shows interest.

In the past, some reporters, through error or carelessness or exaggeration, have violated this unwritten contract with their sources. Frankly, some journalists are just not very good reporters, and they thus contribute to the general image of the reporter in the public mind. This image may be quite poor.

Where the science story has been distorted by opportunism or by over-zealousness or by the journalist not understanding clearly or not hearing the proper term or even by bad luck - such as the story being butchered by an ignorant editor - where this happens, the scientist source becomes "burned".

Thus, if you or a previous journalist has hurt the scientist's image, be prepared for a cool reception. Like the journalistic community, the science brotherhood is a tiny one. Word travels quickly as to which journalists to avoid. This sometimes becomes translated, in most unscientific, but human, way to mean, "If you are a scientist, never talk to the press".

Our best defence in such situations is to come to the interview prepared. If at all possible, the journalist should do some background reading. At least he should be able to ask one direct question that will make sense to the source, i.e. the scientist.

As Mack Laing, a Canadian Associate Professor at the Graduate School of Journalism of the University of Western Ontario observed:

> "Don't forget that the world's best questioners are children. Like you, they have little detailed knowledge on specialized subjects. Like you, they ask questions because they must - to survive and grow."
>
> "Consider a kid's favourite question: WHY? When you are at a loss for the next question in an interview, just ask some variation of 'WHY'."
>
> "It is always a good question to ask a scientist. That is because it is a main question that he is asking of nature. It is, in science, the so-called 'noble' question - the foundation of all scientific inquiry."
>
> "So be child-like. Not childish. There is a difference."

In conclusion, I would urge you not to shy away from science writing. Do not be afraid of it. For science is no longer an esoteric subject. Science and technology are now a public concern, an integral part of our everyday lives.

CHAPTER 6: COUNTRY REPORTS - A SUMMARY

Country reports were presented from 14 of the countries represented at the regional workshop. As might be expected, these reports showed considerable variation in the nature, quantity and quality of attempts to popularize science. But many similarities can be recorded. Some of these and some of the more unusual or unique activities are summarised in the following paragraphs.

In general terms the country reports emphasise the view expressed in the Uganda paper that any discussion on the popularization of science must be related to the politico-socio-economic development of the society. Thus, countries with a predominantly agricultural economy and with a largely rural population have a different perspective to the popularization of science compared with those with any industrialised base and with relatively high proportions of the population in urban environments. Moreover, the popularization of science through the formal educational system can be seen to be more important in those countries with a significant proportion of the school age population in formal education, whereas the non-formal extension-type of popularization of science, particularly agricultural and health science, will be more significant in those societies with low enrolments in the formal school system.

Science Fairs and Exhibitions

Many countries report science fairs, exhibitions and open days as part of their effort to promote the popularization of science. These events are usually an aspect of out-of-school activities for pupils and students in the formal school system. They are invariably arranged by teachers, often with overt support from central or local government.

In some countries, such as Botswana, Swaziland and Tanzania, science fairs are organised by the science teachers' association. In Swaziland, for example, science fairs have been arranged annually since 1969 and now attract considerable public attention and much interest and enthusiasm among the pupils and teachers. The organisation of the annual national science fair is preceded by the arranging of local or regional science fairs, with the best entries going forward to compete at the national event.

Exhibitions of scientific work are again quite usual in many countries. These also are out-of-school activities arranged by individual schools or groups of schools for their pupils. Often the exhibition is displayed at the time of an Open Day or Speech Day of an individual school and, as such, is designed to appeal directly to parents. The Gambia is one country reporting this type of exhibition as a regular feature of secondary school work.

Tanzania reports a different type of exhibition - held in 1982 - sponsored by the Tanzanian National Scientific Research Council as part of its efforts to popularize and promote interest in science. This exhibition, held in the National Museum of Tanzania, was directed at the adult public and was an attempt to create awareness among the general public of the scientific problems of the environment, and other aspects of science and technology. Various Ministries of Government and many organisations

participated in this special exhibition which was timed to coincide with the 10th anniversary of the UN Environmental Programme.

Science Clubs and Societies

Most countries report the existence of science clubs or societies, usually associated with individual schools and science teachers' associations. The viability and activities of such societies and clubs often depend on the enthusiasm and commitment of teacher advisers and officers. The range of activities will vary from club to club but would often involve film shows, debates, lectures and visits.

In some countries there are variations from the usual science clubs. For example, in The Gambia some secondary schools have Young Farmers Clubs, which are mainly responsible for the maintenance of the school farm. In Malta there are more specialised societies organised independently of individual schools, including an astronomical society, a BBC Computer Users' Club and an Ornithological Society. In Kenya, there is an African Wildlife Foundation offering out-of-school programmes for school age students and adults, aimed at popularizing science and emphasising the importance of conservation of the environment. On the same theme there is a national Fauna Preservation Society in Malawi which encourages the establishment of wild life clubs in schools, as well as organising public lectures and field trips.

In many countries there are, in addition, professional societies, such as The Royal Swaziland Science Society, which cater for the needs of the professional scientist and technologist but which also provides some support for the popularization of science. In some cases there are branches, or sections, of internationally established professional bodies. In Zimbabwe, for instance, there are sections of The Royal Society of Chemistry, The Institute of Biology, The Institution of Mining and Metallurgy as well as national societies such as the Solar Energy Society of Zimbabwe, the Wild Life Society of Zimbabwe, the Zimbabwe Institution of Engineers, and many others.

Among the best-known African societies for young people is the Junior Engineers Technologists and Scientists (JETS) of Zambia. This was established in 1968 and supported from the outset by the School of Engineering of the University of Zambia and the Ministry of Education. The Ministry provides financial support for a full-time secretary (administrator) of JETS and opens the door to JETS' activities in all the educational institutions in Zambia. The School of Engineering provides professional support and physical facilities. UNESCO has also supported JETS and used it as a model for out-of-school science activity organisation. Over the country, JETS has sponsored a wide range of activities and projects for young people and has published popular magazines as a way of communicating and popularizing science.

Seminars, Courses and Workshops

Seminars and courses are arranged in all countries as part of in-service training for teachers. Most often these are the responsibility of the Ministries of Education, but in some

countries the initiative is in the hands of societies such as science teachers' associations, with support from the Ministries of Education. In Zambia, for example, the Zambian Association for Science Education (ZASE) has been active in this direction since its establishment in 1966, first at district level, then at provincial and national level.

In Sierra Leone the YWCA has been involved in organising a Basic Science Foundation Course, held at the YWCA Vocational Institute in Freetown. In Mauritius the popularization of environmental studies as a curriculum subject in schools has been enhanced by a series of workshops for teachers and audio-visual programmes for the public.

Rural Development Programmes

Because much of Africa is dependent on agriculture and rural development programmes it is not surprising to find that popularization of science programmes in many countries are concentrating on the rural population through health and nutrition projects, village crafts and similar activities. Many of these programmes are in the hands of Ministries of Health, Rural Development, Agriculture rather than the Ministries of Education and Science.

In Botswana regional health education units of the Ministry of Health organise courses on health. In The Gambia, health workers provide health education through talks, demonstrations and campaigns to the rural, as well as urban, communities. In Sierra Leone the Ministries of Health and Agriculture have designed and implemented rural development projects in all the major administrative regions of the country aimed at improving the living conditions of the rural dweller through improved farming (use of pesticides and fertilisers, improved seeds, modern methods of rearing cattle, fish farming) and better nutrition and sanitation. In Uganda very great emphasis has been placed on rural development with help from international agencies such as FAO, UNESCO and UNICEF. One major project, for example, was the establishment of the Namutamba Pilot Project as a model on the Basic Education Integrated in Rural Development (BEIRD) which has led to the setting up of farms in schools.

Awards and Quizzes

Science clubs and scientific societies, including science teachers' associations often sponsor quizzes and competitions as part of their programme for popularization of science. But among the more significant events reported in the country papers mention may be made of the National Young Scientists Competition of Nigeria. This competition, began in 1980, covers all secondary schools in the country with zonal eliminating rounds held in the 19 different states of Nigeria. Each state eventually selects four finalists who then participate in a National Final Competition consisting of a quiz and a project. considerable media coverage is given to this event.

Swaziland also has a national science quiz, which was launched in 1981 on similar lines to the science fairs, with regional elimination rounds, semi finals and a national final,

organised in three levels for primary, junior secondary and senior secondary school pupils. The Zambian Association for the Advancement of Science (ZAAS) launched an annual award in 1981 for the most outstanding original scientific piece of work. This award, as for many of the other competitions reported, carries a monetary prize as well as a national honour. The financial support for the prizes often comes from an industrial or commercial sponsor.

Media

All countries report the use of the media in the popularization of science, but the nature and extent of such use varies considerably from the straightforward reporting in newspapers and on the radio or television of events such as science fairs and exhibitions to the more positive innovatory attempts to create a climate of public opinion sympathetic to and knowledgeable about science and its applications through science writing in newspapers and journals to science programmes on the radio and television. In some countries (e.g. The Gambia) these programmes may be part of a wider non-formal or continuing education through literacy programmes. In others (e.g. Kenya) they may be part of an extensive network of radio broadcasts to schools through the Educational Media Service. In several countries, the science programmes on the national broadcasting network are based on imported programmes from countries in Europe or North America - series such as 'Wildlife', 'The Ascent of Man', 'The World About Us' etc. Nigeria has attempted a do-it-yourself series on radio, television and in the newspapers to popularize science by showing how simple repairs and modifications to domestic gadgets may be carried out. Tanzania broadcasts a twice-weekly radio programme entitled 'Science Spotlight' in which scientists and organisations are given the opportunity to popularize and explain their specific professions or trades. These range from forestry to pathology and from the chemical industry in Tanzania to environmental pollution resulting from monitoring.

Visits and Museums

Visits to places of scientific interest, including nature reserves, wildlife sanctuaries and museums are included in the programmes of science clubs and societies, but some special efforts are made by certain countries to ensure that such visits are available to all school children, independently of any membership of clubs and societies. The Gambia is one such country which arranges visits by secondary school students to factories, nature reserves, the botanical gardens, the museum and the market.

Museums are now available in all countries, but their activities in popularizing science vary considerably. Some countries have a specific Science Museum; others have Natural History Museums. In Nigeria there is now a national Science and Technology Centre, with branches in all the states of Nigeria, to stimulate interest in science and to provide a centre where visitors can observe and even participate in scientific experiments and where scientific knowledge and understanding can be communicated. In the more industrialised countries such as Zambia the local industrial companies (e.g. the Consolidated Copper Mines Ltd.) play an active and important part in popularizing science. This is not only through visits to the industry but through vigorous programmes for the general public, through the publication of numerous teaching

aids and through in-service training courses for employees in the industry and in its own school system.

CHAPTER 7: DISCUSSIONS IN WORKING GROUPS - SUMMARIES

Group 1 - The Role and Training of the Science Communicator

Science may be defined as a systematic study of knowledge with a view to solving some of the problems of society. In Africa this role of science may be seen in relation to the improvement of the quality of life with special emphasis on the promotion of better health, nutrition and shelter.

Programmes designed to make adults scientifically literate should be incorporated in a general programme of adult education. These programmes may be part of general extension work or may be incorporated within the non-formal programme of established educational institutions. The overall aim, however, should be to provide a basic understanding of science, and its applications to the benefit of society, for all adults.

There are many users of scientific knowledge, i.e. scientists, technologists, policy makers, and the general public, including children, and effective communication among them is vitally important.

Communication among scientists and between scientists and technologists can be achieved by more efficient dissemination of information through publications, workshops and seminars and through the activities of scientific organisations and professional institutions.

Communication between scientists and policy-makers can be brought about by the more effective presentation by scientists of their own ideas and research findings, with particular reference to the applications and benefits of this knowledge, in both short term and long term, to society.

The most effective way of communicating scientific knowledge to the lay public is through well-trained and motivated extension workers and through effective use of the media, particularly the radio and the press. Liaison between scientists and journalists is of paramount importance in this respect.

To improve the procedures, and techniques, of communication, training will be required. Training programmes will be needed for scientists, journalists, educators, extension workers. The following specific suggestions were noted:

(a) In-service training workshops should be organised in science writing, especially for science communicators including journalists, educators, scientists and policy-makers.

(b) More time and space should be devoted in the media for dissemination of scientific knowledge.

(c) The work of science writers and science teachers should be strengthened through the formation and development of professional associations such as science teachers' associations.

(d) Improvement of the quality of science teachers through inducements (e.g. in Zimbabwe science graduates are given 'critical area allowances' to supplement their salaries) and through in-service training.

(e) Inclusion of aspects of science writing and oral presentation of scientific information in all teacher education courses, pre-service as well as in-service, and the introduction of other aspects of communication, such as drama and visual arts, in teacher training programmes.

(f) Increased resources for scientific and technological programmes in popularization. In some countries (e.g. Ghana and Zimbabwe) increased resources are being raised through mandatory levies on industry and commerce.

(g) Encouragement of scientists and technologists to develop interests beyond their own areas of specialisation and to relate their interests to the current and emerging needs of modern Africa.

Group 2 - Mechanisms for Popularization of Science

Science can be popularized and made more relevant to the ordinary day-to-day living of the people by a variety of mechanisms. Among these are the writing of articles and booklets on the achievements of science and scientists to impress on the public that science is about people and that Africa has its own scientists.

In teaching science in schools efforts should be made to use local materials and to use the local environment as a basis for studying science. In this way science can be seen to be locally relevant and obviously related to the day-to-day living in a community.

Parents and the community in general should be involved in the teaching and popularizing of science. Teachers should actively seek ways of involving parents in this process but should always be aware of traditional and cultural habits and inhibitions and be careful not to transgress against them and thus antagonise the local community.

The science teacher has a crucial role to play in the popularization of science but before teachers can carry out this role effectively they must be trained in the mechanisms and techniques. Teachers who have been teaching for a long time, for instance, may need to have their attitudes modified to take account of modern trends to popularize science and to relate science education more closely with the needs of society. Motivation on the part of the teacher is essential, if teachers are to be effective as popularizers of science. Recognition, status and remuneration are important in the motivation process, particularly in the motivation to attend seminars, in-service and refresher courses and workshops. Popularization of science mechanisms and techniques should be included in all training programmes for science teachers. Considerable progress can be made, however, with 'on-the-job' training - as, for example, has been shown in Zimbabwe wth a Zin-tec sheme.

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The types of activities or mechanisms which can be used by teachers, and others, in extra-curricular work will include:

- the organising of science fairs, science exhibitions, open days and public lectures;

- the arranging of seminars, symposia, conferences on scientific subjects of relevance to local communities;

- the organising of field trips, science clubs and conservation activities;

- the holding of school science quizes and the publication of science magazines.

In all these activities it is most useful if the teachers involved operate through a science teachers' association. This sharing of ideas and responsibilities is more productive and efficient.

Industry, commerce and agriculture can and should play an important part in the popularization of science in local communities. Various mechanisms for involving local firms would include:

- the encouragement of pupils/students and teachers to visit industry and agricultural companies to learn at first hand what happens in local firms;

- the sponsorship of competitive science essay writing on topics related to local industry or agriculture;

- the employment of students on a temporary basis during vacations to provide youngsters with some work experience;

- the involvement of industrialists and agriculturalists as advisers on the development of new curricula and in the preparation, including sponsorship, of booklets, posters and other educational aids related to the applications of science;

- the presentation of surplus apparatus and equipment to local schools.

Group 3 - Popularization of Science through the Media

The media are important in the popularization of science because they transgress social and economic barriers and can penetrate vast distances. In Africa, the media are generally centralised, financed and controlled by Governments, but they have enormous potential for presenting and popularizing science and its applications in society.

Popularization of science through newspapers requires good science journalists who can write simply and clearly. Such journalists are generally not available in many African countries and remedial measures need to be taken. In the long term science journalism must be introduced into colleges of journalism. Science writing should be introduced into syllabuses in schools and colleges. In the short term scientists must be persuaded to involve themselves in science writing and in presenting science

in simple clear language through newspaper articles and in magazines. Such tactics would reduce the present dependence on imported material.

The radio has the greatest potential for the popularization of science because it is relatively cheap for individual members of the population to buy the radio sets and the sets are easy to maintain in good working order even in areas where there is no mains electricity. Surveys in some African countries have shown the high percentages of population, even in the remotest areas, to possess radio receivers. The preparation of scripts for radio broadcasts demands careful writing, but the general problems of supply of good science writers for radio are similar to those for science journalists in Africa. The introduction of community radio services as part of a popularization of science programmes for local societies would enhance the potential of the radio.

Television is a relatively new arrival in Africa. In some countries only about 3 per cent or less of the population have access to television, and these would usually be urban dwellers who are already well-educated and well-informed. The expense involved in developing television networks and the high cost of television receivers are major constraints, at present, in the use of television as a popularizer of science. The potential, however, is considerable and the benefits enormous because of the power of the visual image to enhance the presentation of science.

CHAPTER 8: SUMMARY OF RECOMMENDATIONS

The principal recommendations of the working groups endorsed by the workshop at the final plenary session were that:

1 Governments should make deliberate efforts towards the development of policies for the popularization of science.

2 Scientists and other able people should be encouraged to write on the achievements of well known and local scientists and their writings should relate as much as possible to local communities.

3 More inservice training workshops should be organised aimed at imparting skills in scientific writing to various categories of communicators e.g. journalists, educators, scientists and policy makers.

4 The national media should be encouraged to popularize science and technology for development by providing more space and time to scientific information.

5 The work of science writers and science teachers should be strengthened by the formation of professional associations for such groups where these do not exist.

6 Provision is made in all initial and in-service courses of teachers for the inclusion of:

a) scientific talking - both in subject matter and in the mother tongue;

b) scientific writing (including writing in the mother tongue);

c) other terms of communication, e.g. drama and visual communication.

7 Parents and communities should be involved in the popularization activity but due cognisance should be taken of the traditional, cultural demands and inhibitions.

8 Local industries should try to sponsor competitive science essay writing based on the activities of industry.

9 Industries should encourage pupils/students to visit their works to learn at first hand what goes on in those industries.

10 Whenever possible, industries should be prepared to engage students on vacation employment to provide them with practical experience.

11 Colleges of journalism should consider introducing science journalism into their syllabus.

12 Governments should designate one of the existing colleges of journalism as a regional college of science journalism and request assistance from interested international organisations for support of training fellowships.

13 Associations of journalists should encourage their members to attend short courses in science journalism organised by international organisations and that they themselves should take initiatives to organise short courses at national level.

14 Governments should include, in their manpower development programmes, long-term training for science journalists.

15 There should be constant interaction between scientists and journalists to improve the understanding of each other's role in popularizing science.

16 Journalists should take interest in developing their understanding of science.

17 Scientists should be encouraged to take part in the training of science journalists by giving special lectures on basic concepts of science and topical issues in science.

18 Scientists should be encouraged to write popular science articles for the media and be prepared to appear on radio and TV programmes.

APPENDIX A: WORKSHOP OPENING REMARKS

Dr. M. N. G. A. Khan, Deputy Secretary,
Commonwealth Science Council

On behalf of the Commonwealth Secretary General, the Chairman and Secretary of the Commonwealth Science Council, my colleague Mr. E. Apea and on my own behalf, it is my great pleasure to welcome you to this workshop which is organised under the joint auspices of the Human Resource Development Group of the Commonwealth Secretariat and the Commonwealth Science Council, in co-operation with and funding support from UNESCO, International Development Research Centre (IDRC) and the Commonwealth Fund for Technical Co-operation (CFTC). The workshop is hosted by the National Council for Scientific Research, Zambia.

The primary aims of the workshop will be to:

- develop better awareness on the various mechanisms involved in the popularization of science, and

- promote training at national and regional levels to facilitate popularization as well as increased public understanding of science.

The focus of the workshop will be on two target groups:

- Science teacher educators, and

- Science communicators.

We are very pleased that the participants are representative of both these groups. We therefore look forward to a fruitful interaction and a successful workshop.

During this week, through this workshop, we wish to highlight the importance of popularization of science and the various mechanisms which can be employed to achieve this. Popularization by its nature is a long term process, but a modest beginning could be made where it does not exist, and strengthened further where some efforts are in progress. In this task, scientists, teachers and the media all have to recognize their respective responsibilities and be prepared to make positive contributions in discharging them. We hope that this workshop will not only clarify issues but also motivate participants to take follow-up activities on their return home.

We very much appreciate the collaboration extended by UNESCO, IDRC, CFTC and National Council for Scientific Research in organising this workshop, the success of which will ultimately be measured in terms of what the participants gain professionally through their attendance and the activities that will follow.

APPENDIX B: WORKSHOP OPENING SPEECH

Mr. M. M. Sianga MP,
Honourable Minister of State for Higher Education
Zambia

I wish to welcome all participants and resource personnel who have come to Zambia to participate at this regional workshop on the popularisation of science which is being held under the auspices of the Commonwealth Science Council.

On behalf of the Party and its Government and indeed on my own behalf, I extend our welcome to you all. I am sure you will enjoy your stay in Zambia, short as it may be.

Distinguished guests, ladies and gentlemen allow me to say a few words on the programmes of the Commonwealth Science Council. The Commonwealth Science Council is the Commonwealth's agency responsible for linking national scientific establishments in member countries and promotes co-operation in several areas of scientific efforts. In this respect, the Commonwealth Science Council has been able to mobilise resources for the execution of collaborative programmes in the areas of alternative energy, rural technology, standards and quality control, metrication, research management as well as communication between scientists and the public.

Mr. Chairman, I am pleased to inform you that Zambia is one of the member countries which have taken advantage of the Commonwealth Science Council assistance and have initiated projects which form part of regional collaborative programmes supported by the Commonwealth Science Council. Notable projects include improved charcoal production, being undertaken by the University of Zambia and the biogas production undertaken by the National Council for Scientific Research. Furthermore, Zambia has been an active participant in the seminars/workshops organised by the Commonwealth Science Council in the above mentioned programmes. Indeed Zambia feels greatly honoured to have been chosen to host the workshop on the Popularization of Science.

Mr. Chairman, I wish now to turn to the actual organisation of the workshop. I have been informed that the resource personnel for this workshop come from different member countries and backgrounds. Additionally, participants are expected to exchange their experience on the subject matter of the workshop. This I should say is a commendable strategy because it reflects the true international nature of the activities of the Commonwealth Science Council and ensures cross fertilisation of ideas. I do realise that we all have high expectaticns of the experiences of the resource personnel but let me take this opportunity to urge participants who I believe are experts in their own fields to actively contribute to the deliberations of the workshop.

Mr. Chairman, allow me now to turn to the contents of the workshop. We are all aware that science and technology are an important instrument for a nation's sustained development.

Science which is the subject of this workshop forms the base for technology development: hence its importance. This importance was underscored at the United Nations Conference on Science and Technology for Development which was held in Vienna, Austria in August 1979. At continental level, heads of member states of the Organisation for African Unity (OAU) met in Lagos, Nigeria, in 1980 and were unanimous in recognising the existence of the need to "induce profound change with far reaching effects on the use of science and technology as a basis of Africa's socio-economic development.

Here in Zambia, science and technology form one of the five areas identified by the Party and its Government to enhance socio-economic development of the nation. Mr. Chairman, science is evidently an important instrument of development and should be inculcated in our culture by popularizing it. Hence the timing of this workshop is extremely significant in the light of our awareness of the role science and technology can play in our socio-economic development. Mr. Chairman, I am informed that this workshop will address itself to the development of better awareness on the various mechanisms involved in the popularization of science and promotion of training at national and regional levels to facilitate popularization as well as increase public understanding of science. This will be achieved by exposing science teachers and science communicators such as journalists, broadcasters, writers and readers to the above techniques. The difficulties associated with learning of science subjects and hence their low level of popularity among our school-going population cannot only be attributed to inadequate requisite facilities for the proper teaching of the subjects but also to the fact that science and technology have not been adequately inculcated in our culture. Since culture forms the backbone of our communities and therefore a foundation of our attitudes to human efforts, it is extremely important that science should be popularized at grass-root levels. Populatization of science should be an integral part of our national efforts to increase our capabilities in science and its application to our development. Efforts in this regard together with those aimed at improving conditions of teaching science subjects will enhance the popularity of science subjects and therefore lead not only to our increased capacity in science but also to the use of science in other efforts of development.

Mr. Chairman, I am informed that fifteen countries are represented at this workshop. At most, each country is represented by the two participants except Zambia which has the largest representation because of cost advantage. If you may allow me to go through the list of the countries represented: these are Botswana, Cyprus, the Gambia, Ghana, Kenya, Malawi, Malta, Mauritius, Nigeria, Sierra Leone, Tanzania, Uganda, Zambia and Zimbabwe; not in their order of importance but purely in alphabetical order. Manpower requirements for the sort of skills the workshop is intended to provide far exceed the number of participants present here. This workshop should therefore strive to provide a form of training that goes beyond the narrow circle of those who are here. To some extent, this will happen through the interaction of the graduates of this workshop with friends and workmates upon their return to their respective stations. This task, I guess, is much easier since the workshop will equip its graduates with mechanisms for popularization of science through formal and non-formal education systems. There are other ways which this workshop can

use to achieve further multiplier effect. I would like to give the workshop organisers a challenge to record all the proceedings which can later be used as lecture or reading material and increase the audience of the workshop. It is also my hope that institutions and countries which have sent their representatives at this workshop will make a deliberate effort to ensure that knowledge acquired therefrom reaches other relevant sectors and individuals.

Mr. Chairman, may I now take this opportunity to thank the Commonwealth Secretariat and the Commonwealth Science Council for their efforts in assisting member states to increase their capabilities in science, and in particular in sponsoring this workshop. I also wish to thank the local organising committee chaired by the National Council for Scientific Research who have made the local arrangements possible. I hope that the success of this workshop shall reflect the efforts made by the Commonwealth Secretariat and the Commonwealth Science Council and the local organising committee. I also wish to thank the Zambia Institute for Mass Communication for putting their facilities to the service of this workshop. With these few words I now declare the Regional Workshop on the Popularization of Science officially open and wish our guests an enjoyable stay in Zambia.
Thank you!

APPENDIX C: CLOSING REMARKS

M. N. G. A. Khan, Deputy Secretary
Commonwealth Science Council

In the history of mankind, the present century represents an era of greatest scientific and technological revolution. Over the past fifty years alone mankind has witnessed the atomic age, space age and now the computer and communication age. Advances in science and technology have permeated every aspect of human life, but unfortunately, the benefits of these are very poorly spread within and between communities and nations. Societies have become stratified in terms of those with good science education and capabilities and those with poor or without. Nations continue to belong to more advanced and less advanced groups in terms of scientific vis-a-vis economic progress. It is increasingly clear that scientific and technological emancipation is at the centre of economic progress and development. It is also evident that real source of wealth is no longer raw materials, the labour force nor machines, but rests in a well educated manpower base. Education, in particular science and technology related education, has become the real wealth of this new era. Popularization of science, which encompasses science education in its broadest sense, is therefore simply not a desirable goal, but I believe, is imperative to assist development.

During the deliberations, it became very clear that there are various levels in which popularization can be achieved. The science content of school curricula should be the first target. The goal should be to attract as many pupils as possible to do science at school and afterwards. Science teaching needs to be made interesting to the pupils. Science as a career needs to be made attractive.

Popularization of science should be treated as a national goal, attainment of which should be encouraged through the formal education system and through continuing education. The role of the media in this regard is very important.

I share the view that for science and technology to be regarded as an integral part of each culture, these should preferably be taught in the mother tongue. In many countries special efforts have to be made to have text books and teaching materials available and teachers trained to communicate effectively in the vernacular. Science and technology will not take root in a society unless these can be communicated freely in the mother tongue. In saying this, I am not minimizing the difficulties in achieving such goals. In many countries, there are several languages none of which are well developed to be used as a medium for science and technology education; use of an international language in science and technology education may or may not provide the right answer in the long run.

Scientists in every country have pioneering roles to play in uplifting their societies and bringing them to the scientific

age. For this they not only have to communicate with each other, the fellow scientists at home and abroad, but also with the public at large. They should also improve their capabilities in their mother tongue, as in many developing Commonwealth countries scientific higher education will have been received in English. Scientists should take up translation work of foreign science books to local languages for different readership. They should write in the newspapers and explain major scientific and technological developments worldwide as well as their own work and national problems deserving scientific solutions. They should also make use of the radio and television to propagate science. They should establish close working relationships with science journalists as well as trying to become science journalists themselves.

Scientific organisations in every country should institute adequate mechanisms to communicate with their own public by publishing brochures, reports etc., both in local language and in English and organising open days, symposia and conferences. They should project themselves as agencies which are not only aware of the latest advances in science and technology world wide but also in touch with basic developmental problems of the country and contributing meaningfully to their solution. In doing these, credibility is of essence and empty propaganda should be avoided. By deliberate choice, scientific organisations should build up capacities to communicate science and technology in the various languages of the country. Science and technology can be explained in simple terms if the communicator has a grasp of the subject matter as well as a command of the language used for communication. It is a sad reality with most developing country scientists that they can communicate science and technology only in a foreign language, but this is not an insurmountable problem. Scientific communication both in local and foreign languages should be regarded as an integral part of scientific pursuits covering both education and research.

Science is a cumulative profession in the sense that any present work is built on previous work. Ready access to information of what has been achieved so far is vital. It is equally important that any current work is published speedily. For these every country must have libraries, scientific journals and funds to subscribe to international publications and journals. But unfortunately due to inadequate provisions of these, scientists in developing countries are forced to grope in the dark and suffer terrible isolation. In designing a research programme they are not sure if the work has already been done. In preparing for publishing their research results they have the same uncertainty. This discourages many from completing their work and publishing, thereby limiting scientific communication. In short, they lack self-confidence which is a pre-requisite for any creative work - which science and technology are.

During this week, through this workshop, we have attempted to highlight the importance of popularization of science and the various mechanisms which can be employed to achieve this. Popularization by its nature is a long term process, but a modest beginning could be made where it does not exist, and strengthened further where some efforts are in progress. In this task, scientists, teachers and the media all have to recognize their respective responsibilities and be prepared to make positive contributions

in discharging them. In all these, the young people should be the first target group for they will have to be prepared to live in a future age which is bound to be even more science and technology oriented than today. We hope that this workshop has been able not only to clarify issues but also motivate participants to take follow-up activities on return home.

I feel happy that the recommendations arising out of the workshop reflect its objectives and therefore constitute a successful event. But you will agree with me that this is just an immediate success, a prelude to a new beginning. In the months and years ahead we would like to foresee activities at the national level where the participants will be involved in organising similar workshops making contributions to the various media, encouraging others to do so, making science education more interesting to pupils, extending science education to parents and other members of the community and making in short science more visible and better understood. And when that happens, that will be a true measure of the success of this workshop.

We very much appreciate the collaboration of UNESCO, IDRC, CFTC, the National Scientific Research Council, the Organising Committee for this workshop, the resource persons, rapporteurs and those who worked behind the scene in making this workshop possible. I hope that the participants will keep in touch with each other and with us at the Commonwealth Secretariat on their post-workshop activities. The comradeship that has developed during this week deserves to be sustained and all of us must make efforts to ensure this.

APPENDIX D: WORKSHOP PROGRAMME

1.	Opening	
2.	Keynote Address	D. Bekoe
3.	Introduction to the Workshop	M. Khan/E. Apea
4.	Country Reports	Participants
5.	The Role and Training of the Science Communicator	E. Apea/M. Khan
6.	Mechanisms for Popularization of Science	
	a) The Education System (Formal/Informal)	A. Salisbury
	b) The Media	J. Castley (Ms)
7.	Group Discussion - I/Follow-up	
8.	a) Science Writing - Popular Press - Science Readers - Reporting/journalism	Abdallah Ngororo
	b) Appearing for Radio Programmes	J. Castley/Journalists from Zambia
	c) Appearing for Television Programmes	J. Castley/- do -
	d) Appearing at a Press Conference	J. Castley/E. Apea/Journalists from Zambia
9.	Group Discussion II/ Follow-up Projects	
10.	Adoption of Recommendations/ Closure	

APPENDIX E: DIRECTORY OF PARTICIPANTS

Country	Name of Participant	Address
Botswana	Ms Felicity M Leburu Senior Curriculum Development Officer (Science)	Ministry of Education Curriculum Development and Evaluation Department P O Box 221 Gaborone
"	Mr K H Nkarabang Senior Information Officer (Science)	Department of Information and Broadcasting P Bag 0060 Gaborone
Cyprus	Mr Demetrios A Phinios Science Educator/ Lecturer	The Pedagogical Institute of Cyprus Nicosia (P.I.)
Gambia	Mr Samuel Mentore Njie Principal	St Augustine's High School P O Box 463 Banjul
Ghana	Mr Samuel Nana Inkoom Scientific Information Officer	C S I R P O Box M 32 Accra
Kenya	Ms Kigoto G Nyambura Primary Science Curriculum Development Officer	Kenya Institute of Education P O Box 30231 Nairobi
Lesotho	Mr Leloko Mohale Journalist	Information & Broadcasting Maseru
Malawi	Dr E J Sendezera Chairman of the Association for the Advancement of Science in Malawi	Physics Department Chancellor College Box 280 Zomba
"	Mr R H Manondo Principal Inspector of Schools (Science)	Ministry of Education & Culture P Bag 328 Lilongwe 3
Malta	Mr Carmel Chetcuti Headmaster	Department of Education, Valletta
Mauritius	Mr Soomerjeet Sungkur Inspector of Schools	Ministry of Education, Art and Culture Edith Cavell Street Port Louis

Country	Name of Participant	Address
Nigeria	Mr S Auta Assistant Director of Education	Federal Ministry of Education, Science & Technology 9 Kofo Abayomi Street Victoria Island Lagos
"	Mr Alabi Oke Deputy Chief Scientific Officer	Federal Ministry of Education, Science & Technology 9 Kofo Abayomi Street Victoria Island Lagos
Sierra Leone	Mr Edward T Ngandi	Institute of Education Tower Hill Private Mail Bag Freetown
Swaziland	Mr Bethuel Sibusiso Ndlovu Lecturer	Nazarene Teachers College P O Box 602 Manzini
"	Mr Ambrose Vusumuzi Gama Science Tutor	Emalatini Development Centre P O Box 547 Mbabane
Tanzania	Miss Cecilia N Mushobozi Scientific Officer	Tanzania National Scientific Research Council P O Box 4302 Dar es Salaam
Uganda	Mr. Kulazikulabe Patrick Wilson Principal	Shimoni Teachers College P O Box 7112 Kampala
"	Miss Fridah Kakooza Journalist	Ministry of Information and Broadcasting P O Box 7142 Kampala
Zambia	Mr A P Anand Head of Chemistry	Zambia Consolidated Copper Mines Mining Industry Technical Services P O Box 260071 Kululushi
"	Mr P D Chasweka Lecturer in Physics	Nkrumah Teachers College P O Box 80404 Kabwe
"	Mr J Fredrick Charles Head of Science Dept.	DLTT College Private Bag 1 Livingstone

Country	Name of Participant	Address
Zambia	Mr C F Chiyenu Senior Inspector of Schools	Ministry of Higher Education Teachers Training P O Box 50464 Lusaka
"	Mr Patrick Fungamwango Journalist	Zambia Daily Mail P O Box 31421 Lusaka
"	Ms Chipo Grace Programme Officer for Sciences	Zambia Commission for UNESCO P O Box 50619 Lusaka
"	Mr T M Hamusute Headmaster/Senior Science Teacher	Ibalelo Secondary School Box 850039 Serenje
"	Dr Hikabali Benson Himonga Physician - Epidemiologist	Ministry of Health P O Box 30205 Lusaka
"	Dr N Sitwala Imenda Lecturer	University of Zambia P O Box 32379 Lusaka
"	Mr Wilfred M Kaiba Inspector of Schools	Ministry of General Education & Culture P O Box 50093 Lusaka
"	Mr Baldwin Kandinda Head of Science Education Department	Mwense Secondary School P O Box 760100 Mwense
"	Mr A C Kaunda Chief Geologist	Mining Industry Technical Services ZCCM Limited Box 260071 Kalulushi
"	Mr Moses Kondowe Research & Development Co-ordination & User Liaison Officer	National Council for Scientific Research P O Box CH 158 Chelston Lusaka
"	Dr D M Lungu Plant Breeder Lecturer	University of Zambia School of Agricultural Sciences P O Box 32379 Lusaka

Country	Name of Participant	Address
Zambia	Mr S C Lushibashi Headmaster/Chairman Zambia Association for Science Education	Chinsali Day Secondary School P O Box 480228 Chinsali
"	Mr Stanley M Mukonde Assistant Lecturer	Zambia Institute of Mass Communication P O Box 50386 Lusaka
"	Mr John S Mukwangole Lecturer/Producer	Educational Broadcasting Services Box 50231 Lusaka
"	Mr W C Mushipi Documentalist/Informa- tion Scientist	National Council for Scientific Research P O Box CH 158 Chelston Lusaka
"	Mr Peter Mwamfuli Chief Research & Development Coordination and User Liaison Officer	National Council for Scientific Research P O Box CH 158 Lusaka
"	Mr P J Njeleka Editor Youth Magazine	Freedom House P O Box 30302 Lusaka
"	Mr Joseph Chileshe Nondo Scientific Officer II	National Council for Scientific Research P O Box CH 158 Chelston Lusaka
"	Mr B C Sichela Journalist/Science Writer	P O Box 34400 Lusaka
"	Mr Godwin Sifafula Acting Principal Information Officer (Technical Services)	Zambia Information Services Mass Media Complex P O Box 50020 Lusaka
"	Mr Chiyenga Simposya Research Scientist	National Council for Scientific Research P O Box CH 158 Chelston Lusaka
"	Ms C G Simwemba Programme Officer for Science and Technology	Zambia National Council for UNESCO P O Box 50619 Lusaka
"	Mr Peter Soko Journalist	Times Newspapers (Z) Ltd P O Box 30394 Lusaka

Country	Name of Participant	Address
Zambia	Dr Jassiel N Zulu First Secretary ZAAS Zambian Association for the Advancement of Science	University of Zambia Department of Biology P O Box 32379 Lusaka
Zimbabwe	Mr I C Chiri Scientific Liaison Officer	Scientific Council Cabinet Office P O Box 8510 Causeway
"	Mr C E Chimombe Deputy Chief Education Officer	Curriculum Development Unit Ministry of Education Private Bag 8022 Causeway Harare

Resource Persons

Organisation	Name and Address
Unesco Regional Office for Science and Technology for Africa	Dr Daniel A Bekoe Director Unesco Regional Office for Science & Technology for Africa P O Box 30592 Nairobi Kenya
British Broadcasting Corporation	Ms Jerusha Castley Broadcaster/Journalist BBC African Service Bush House Strand London WC2B 4PH Britain
International Development Research Centre	Ms Fibi Munene Regional Liaison Officer Communication Division P O Box 52084 Nairobi Kenya
Tanzania Information Services	Mr Abdallah M Ngororo Director of Information Tanzania Information Services P O Box 9142 Dar es Salaam Tanzania
University of East Anglia	Dr Andrew J Salisbury Chairman, Mathematics and Science Education School of Education University of East Anglia Norwich NR4 7TJ
Commonwealth Secretariat	Mr Emmanuel Apea Chief Project Officer Education Programme Commonwealth Secretariat Marlborough House Pall Mall London SW1 Britain
"	Dr M N G Azam Khan Deputy Secretary Commonwealth Science Council Commonwealth Secretariat Marlborough House Pall Mall London SW1 Britain